RECORD OF DECISION AMENDMENT

DECISION SUMMARY

SAN GABRIEL AREA 1

INITIAL REMEDIAL MEASURES

September 1987

SUMMARY

Large areas of the San Gabriel groundwater basin, Los Angeles County, California, have been found to be contaminated with chlorinated hydrocarbons. San Gabriel Area 1, a plume of groundwater contamination located primarily underneath the city of El Monte, was included on EPA's final National Priorities List in May 1984.

In 1980, the State of California began an extensive well water testing program in the San Gabriel basin which found numerous wells contaminated with trichloroethylene (TCE), tetrachloroethylene (PCE), and other chlorinated hydrocarbons. The California Department of Health Services (DOHS) directed public water companies in the area to periodically test their wells. State Action Levels for TCE and PCE were set at 5 and 4 parts per billion (ppb), respectively, based on the Environmental Protection Agency's (EPA) Suggested No Adverse Response Level (SNARL). If alternative methods of reducing PCE and TCE concentrations below the Action Levels (such as blending waters from different wells) are not effective, wells must be removed from service. In 1983, when EPA became involved in addressing this problem, there were three mutual water companies--Richwood, Rurban Homes, and Hemlock--that had no alternative water supply and had been providing their customers with water that is contaminated with PCE at concentrations above the DOHS Action Level.

In May 1983, a management committee comprised of EPA, various state and local agencies, and representatives of various water companies and public interest organizations was established with California DOHS as its chair. The objectives of this committee are: 1) to find a solution for the three mutual water companies that have a well contamination problem and have no alternative water supply; 2) to identify and control any TCE/PCE sources; and 3) to develop an overall strategy for management of the plume areas.

To address this first objective, EPA directed its contractor, CH_2M Hill to evaluate alternative initial remedial measures (IRM) to solve the mutuals' water contamination problems during the interim period before a final long-term solution to groundwater contamination in the San Gabriel basin is implemented. This evaluation was summarized in a Focused Feasibility Study dated December 6, 1983.

On May 11, 1984, after a formal public comment period, EPA Region 9's Regional Administrator signed a Record of Decision (ROD) selecting air-stripping treatment as the most cost-effective initial remedial measure (IRM) to provide three small mutual water companies in El Monte with a source of uncontaminated water. During the design phase of the IRM, it became apparent that the cost to construct and operate air-stripping systems would be much higher than estimated in the Focused Feasibility Study (FFS) and the ROD, due to the severe site constraints associated with designing and constructing treatment systems for the mutuals. In addition, to design an air-stripping system that the mutuals could operate reliably, and which would not result in adverse impacts on the neighboring community, would require the addition of a 60,000 gallon storage reservoir to the treatment system at each mutuals' well site.

As a result of these findings, revised cost estimates have been developed for all of the alternatives considered in the ROD. Based on these revised cost estimates, and on the other relative advantages and disadvantages (non-cost factors) of the feasible alternatives, EPA has determined that carbon adsorption treatment is now the cost-effective alternative.

DISCUSSION

I. Background

On December 6, 1983, EPA's zone contractor, CH_2M Hill completed a Focused Feasibility Study (CH_2M Hill, 1983) which evaluated various alternative initial remedial measures (IRM) which would provide three small mutual water companies in El Monte with a source of uncontaminated water. The three companies--Richwood, Rurban Homes, and Hemlock Mutual Water Companies--had wells contaminated with tetrachloroethylene (also known as perchloroethylene or PCE). While other water companies in San Gabriel Areas 1-4 also have contaminated wells, only these three mutuals were unable to provide water that meets the EPA Suggested No Adverse Response Levels (SNARL) for a 10^{-6} cancer risk level for PCE and trichloroethylene (TCE). Larger water companies have taken interim actions such as shutting down contaminated wells or blending water from clean and contaminated wells to meet the SNARL level. These options were not available to the three mutuals.

The Focused Feasibility Study (FFS) identified several feasible alternatives to solve the mutuals' problems. After a formal public comment period and a public meeting to which all members of the mutuals were invited, Region 9's Regional Administrator signed a Record of Decision on May 11, 1984 selecting air-stripping treatment as the cost-effective IRM for San Gabriel Area 1 (U.S. EPA, 1984). Two alternatives that were technically feasible and lower in cost than air-stripping were not selected as the cost-effective IRM due to institutional problems. The lowest cost alternative, under which the mutuals would obtain water from a nearby water company while leasing their water rights, was not selected because no nearby water company was identified which would agree to provide water under such an arrangement. The next lowest cost alternative was for the mutuals to dissolve as independent water companies and join a nearby water company. This alternative was not selected after the membership of each mutual voted not to dissolve.

After the Record of Decision was signed, EPA issued a work assignment to its contractor, CH_2M Hill, to design air-stripping treatment systems for the Richwood and Rurban Homes Mutual Water Companies. The third mutual, Hemlock, declined to have an air-stripping system provided as an IRM and has instead purchased and installed its own carbon adsorption system. In June of 1984, the design team from CH_2M Hill visited the mutuals' well sites to obtain background information on the present water systems' operating characteristics and to obtain water samples for full organic priority pollutant analysis. The purpose of the water analyses was to confirm that the only contaminants present were volatile organics which could be treated with an air-stripping system. The results of these analyses confirmed that PCE was the only contaminant present in the mutuals' well water at levels of concern.

After the initial site visit, CH_2M Hill recommended the preparation of a Pre-Design Study of air-stripping systems for the Richwood and Rurban Homes mutuals. The site visit had identified several severe constraints that would be imposed on the system design due to the limited site area, high peak water flows in the systems, close proximity to neighbors at the well sites, and the need to design a system which the mutuals could operate reliably (since the California Department of Health Services (DHS) at that time planned to require the mutuals to be responsible for system operation and maintenance). The purpose of the Pre-Design Study was to investigate different configurations of air-stripping systems to determine the most cost-effective and reliable configuration before proceeding with the final system design. EPA authorized CH_2M Hill to begin this study in July 1984.

II. The Pre-Design Study

During the Pre-Design Study, CH_2M Hill identified and focused on five major considerations in the development of an air-stripping system design:

1) Peak Factor. For both mutuals, there is a constant cycling of water flow in the system from zero to as high as 880 gallons per minute. These flow rates are caused by the cycling on and off of the mutuals' wells during operation. The reason for this constant cycling of the wells is that the mutuals lack the reservoir capacity that would be available in a standard waterworks system. Both mutuals have only small pressure tanks at the well sites which feed directly into the distribution system. When the pressure in the system drops below a certain set value, the pumps turn on long enough to raise the pressure back above that value.

Since the flow rate of the system is an important design criterion, a flow rate study of the mutuals' systems was conducted. Multiple time-volume measurements were used to determine the well pumping rates for Richwood and Rurban Homes. Average flow rates were determined by estimating the length of time each pump operated during the month and using the measured pumping rate. The results of the flow rate study showed that the average flow rates of the mutuals' water systems were underestimated during the FFS, by as much as 79% in the case of Richwood's system. The average flow rates used in the FFS and the revised estimates for Richwood and Rurban Homes are summarized in the table below. These findings are especially significant since the flow rate can have an important effect on the design of alternative water supply systems, as well as on their associated capital and operating costs.

Water System Average Flow Rates

Mutual Water Company	Focused Feasibility Study Estimate (gallons/minute)	Revised Estimate (Pre-Design Study) (gallons/minute)	Percent Difference
Rurban Homes	135	210	+56%
Richwood	95	170	+79%

2) Operational Simplicity. The mutuals are presently certified to operate their existing water systems. Since the present systems are not complex, they do not employ highly trained individuals as system operators. Thus, operational simplicity is desirable for the treatment systems in order to reduce the impact on the mutuals' operation of their waterworks system, and to ensure reliable operation of the treatment system.

3) Limited Area Available. Both mutuals have limited area available at their well sites for construction of a treatment system. This imposes a serious constraint for facility construction especially for the Richwood mutual which has the smaller well site. Special site preparation and construction procedures will be required, affecting the capital cost of the system.

4) Close Proximity of Neighbors. The sites are very close to neighboring residences. Thus, the community will be sensitive to any noise produced by the treatment systems, especially at night.

5) Cost. It became clear in the early stages of the Pre-Design Study that the combination of site constraints would lead to increased costs in the design and construction of air-stripping systems for the mutuals, well above those estimated in the FFS. To enable EPA to compare the costs of different air-stripping system configurations, both capital and operating costs were developed for all the treatment system configurations evaluated.

CH_2M Hill identified two potential air-stripping treatment system configurations for the mutuals. The primary difference between the configurations was whether or not a 60,000 gallon storage reservoir was installed in addition to the air-stripping towers. Also, when it became apparent that the cost of air-stripping treatment was going to be much higher than previously estimated, CH_2M Hill also revised the conceptual design and costs for carbon adsorption treatment systems for the mutuals. Carbon adsorption was reconsidered since it was identified in the FFS as the next most cost-effective feasible alternative after air-stripping, and also because it has several other advantages. The three treatment system configurations evaluated during the Pre-Design study are briefly described as follows, along with a discussion of their relative advantages and disadvantages, as identified during the Pre-Design Study (CH_2M Hill, 1984). The revised cost estimates for the treatment system configurations will be discussed in a later section.

1) Air-stripping without a storage reservoir. This alternative is the system envisioned in the feasibility study. Water would be pumped directly from the well to two parallel air-stripping towers, and then pumped to the existing pressure tanks at the site before distribution to the mutuals' members. A major problem with this alternative is that the well pumps presently cycle on and off continuously every few minutes 24 hours a day. Similar cycling of the air-stripping system may create potential problems concerning system reliability. The continuous cycling of the air-stripping system may cause excessive equipment wear. In addition, operation of this system would require the use of a sophisticated microprocessor control system. This is necessary to control the constant cycling on and off this system would require. Operation of a complex control system is probably beyond the capability of the mutuals present staff. This is a serious problem, since DOHS planned to negotiate a letter of understanding or contract with the mutuals under which the mutuals would be responsible for ongoing operation and maintenance of the air-stripping system. Thus, the reliability of the system may be in question if this treatment system configuration is implemented.

There are several other disadvantages associated with this alternative involving potential adverse impacts on the community surrounding the well sites. This air-stripping system configuration would require essentially 24-hour operation with the system constantly cycling on and off. The constant cycling may cause electrical surges in the neighborhood. In addition, continuous operation may create a noise problem, a particularly severe disadvantage given the fact that the sites are located in residential neighborhoods within 200 feet of nearby houses. Operation of an air-stripping system will increase the noise levels at the well sites due to the air blowers installed at the bottom of each air-stripping tower. Although noise barriers would be included in the system design, it may not be possible to completely mitigate the impact of increased noise during night-time operations. Finally, another disadvantage to this configuration is that the system would require monthly shutdown of the towers for an hour or two for disinfection. While this can be done for one tower at a time, it would have to be done at periods of low demand or else water use would have to be restricted during this activity. A drainage system would have to be installed to dispose of effluent during this system flushing.

2) Air-stripping with a storage reservoir. This system would have the same configuration as the first alternative except that the system would also have a 60,000 gallon storage reservoir. This would be a below-grade or partially below grade concrete reservoir, with the air-stripping towers installed directly above the reservoir. This would allow the air-stripping system to operate continuously for longer periods of time and would reduce the potential reliability problems. Less frequent cycling of the system would reduce equipment wear. This configuration would also not require the sophisticated control system of the first alternative, because the wells could pump continuously for longer periods of time while filling up the reservoir. This treatment system configuration would require much less change in the mutuals' current system operation than the other air-stripping configuration, and therefore, operation of the system by the mutuals should be more reliable.

In addition to the advantages in terms of reliability, this air-stripping system configuration has several other advantages. The reservoir would store enough water so that in most cases, the system would not have to run at night, thereby solving the potential noise problem. In addition, more continuous operation of the system will reduce the frequency of power surges in the neighborhood. Another advantage of this configuration is that, because of the reservoir, no restrictions on water use would be required during maintenance shutdowns of the towers.

While this alternative would provide much more reliability and ease of operation than the first alternative, it has the disadvantage of approximately 50% higher capital costs, and greater land requirements. The latter disadvantage is particularly significant for Richwood's situation since their well site has very limited area available for construction. Additional contingency was added to the cost estimate for constructing this system configuration at Richwood's well site due to this complicating factor.

There are also two disadvantages common to both of the air-stripping system configurations. First, heavy construction equipment would be required to install these systems and both sites have limited area. At Richwood, and possibly at Rurban Homes, it would require that easements from neighboring land-owners be obtained that allow this equipment to park and operate on their land. Second, for any air-stripping configuration there is a potential community concern with air emissions from the systems. In this case, the estimated emissions are quite low and should not create any potential public health or environmental problem. Before construction of air-stripping systems, EPA planned to follow the South Coast Air Quality Management District's review process for air-stripping towers. This process includes modeling the estimated emissions to determine potential community exposure, followed by completion of a health risk assessment by DHS's Epidemiology Studies section.

3) Carbon adsorption. Carbon adsorption has many operational advantages over air-stripping. A carbon system could be placed within the mutuals' existing water systems without changing the mutuals' current system of operating their wells. The system would require no control system beyond that which is already in the mutuals' systems. The system would be easy to operate and maintain. The only required maintenance would be that the carbon be changed periodically (approximately once or twice a year). Activated carbon supply companies could be contracted with to recharge the carbon vessels and haul away the spent carbon. Except for this activity, the mutuals could operate exactly the same as they do now. A carbon system is smaller in size than an air-stripping system, thereby making it easier to design the system to fit in the small space available on-site. In addition, it would not require as extensive construction activity as would be required to install an air-stripping system. At the Richwood site, it may be possible to install separate carbon systems at each well site, eliminating the need for a connecting pipe between the sites (one well site is obviously too small for an air-stripping tower, thereby necessitating the connecting pipe for those alternatives). Another factor which could affect the mutuals' members satisfaction with an EPA-installed treatment system is the resulting taste of the water. An air-stripping system will remove carbon dioxide from the water which would affect the water's taste. However, a carbon system should have no affect on the taste of the mutuals' water (except for the effect of chlorination, which is common to both air-stripping and carbon adsorption). Carbon adsorption also offers an advantage regarding the protection of public health in that it is not designed specifically to remove PCE. A carbon system would remove a wide variety of organic as well as inorganic contaminants. On the other hand, the air-stripping tower would be designed to remove a specific concentration of

PCE. While other volatile contaminants would be removed, the removal efficiency would depend on the relative volatility of the contaminant. As an example, TCE is relatively less volatile than PCE. Finally, one last advantage of a carbon system is that there are no air emissions produced, thus eliminating air emissions as a potential cause for community concern.

The primary disadvantage of the carbon adsorption alternative is that the operation costs are over three times higher than those for air-stripping. This was considered a major disadvantage since DHS had developed a policy regarding operation and maintenance (O&M) requirements which can be summarized as "When a remedial action directly benefits a viable public or private organization that is willing and able to provide for future maintenance of such an action, it is DHS's intention to obtain commitment for this maintenance from this organization." In this situation, DHS had taken the position that the mutuals should pay for ongoing O&M. Unfortunately, the high estimated operating cost of the carbon adsorption alternative would cause an increase in the mutuals' members average monthly water bill of over 400%--from approximately $8 to as high as $41 per month--an increase in cost which the mutuals members would probably not agree to. In addition, if contaminant levels rise to much higher levels, O&M costs would go up as more carbon is used. O&M costs for an air-stripper are generally constant over a range of contaminant levels (This assumes, of course, that the air-stripping system is designed to handle the increased levels of contamination.).

Evaluation of an Upgrade to Hemlock's Existing System.

When EPA became aware that the cost of carbon adsorption systems for Richwood and Rurban Homes would be comparable to the cost of air-stripping systems, a reevaluation of Hemlock's situation was included in the Pre-Design Study. Hemlock had declined to participate in the IRM project when air-stripping was selected by EPA as the most cost-effective alternative. Instead, they had purchased and installed a carbon adsorption system to treat their drinking water. While pilot tests had shown that their system would adequately treat the contaminated water from their wells, their system was not designed with the same design standards proposed by EPA for Richwood and Rurban Homes in the Pre-Design Study. In addition, DHS required that Hemlock install a flow restrictor on their water system to ensure adequate treatment of their well water. The flow restrictor limited the rate at which well water could be treated by the carbon adsorption system and could possibly cause problems with low water pressure in the systems at times of peak water use. Therefore, as part of the Pre-Design Study, EPA directed CH_2M Hill to evaluate the feasibility and costs of improving Hemlock's treatment system to meet the design standards used to design carbon adsorption systems for the other mutuals. This evaluation proved that installing an upgrade to Hemlock's system was probably cost-effective in comparison to air-stripping, since the design of an air-stripping system for Hemlock would be affected by the same constraints associated with Richwood and Rurban Homes' systems.

III. Activities Subsequent to Completion of the Pre-Design Study.

Consultation with DHS

When the Pre-Design Study was received by EPA in October 1984, discussions were held with DHS to determine which alternative they recommended and if the DHS policy concerning provision of O&M costs for the IRM had changed. In a letter dated October 24, 1984, DHS made the following statements:

1) All of the alternatives examined in the Pre-Design study appeared to have similar cost-effectiveness when considering the combined technical, social, and cost aspects of each. They supported the idea of presenting the results of the Pre-Design Study to the mutuals and obtaining their preference for the IRM.

2) Since EPA (in the State Superfund Contract with DHS) is requiring the State to assure O&M for the design life of the system (20 years), DHS feels that the cost analysis should examine 20-year present worth costs, as well (instead of the 5-year time period used in the Pre-Design Study). Based on its low operating cost, it appears that air-stripping is still the preferred alternative.

3) DHS has received letters of intent from the mutuals regarding their commitment to provide funds for long-term O&M.

Community Relations Activities

After CH_2M Hill's site visit in June 1984, the mutuals were informed by EPA that a Pre-Design Study would be conducted. Once the study and the subsequent consultations with DOHS were completed, the Pre-Design Study was sent to the Board of Directors of the Richwood and Rurban Homes mutuals for their review. A meeting between EPA and the Boards of the mutuals was held in El Monte on November 7, 1984. At this meeting, the results of the Pre-Design Study were presented to the mutuals' Boards along with estimates of the annual operating costs, for which the mutuals would be responsible for providing funds, under each alternative. EPA requested guidance from the mutuals' boardmembers as to whether they thought another full meeting of the mutuals' shareholders should be held given the major change in estimated costs for the alternatives.

The boardmembers of the Rurban Homes mutual decided at this meeting that a meeting for their shareholders was not necessary. In addition, based on the information provided by EPA and in the Pre-Design Report, they selected the air-stripping system configuration that included the storage reservoir as their preferred alternative. They specifically stated that even though the carbon adsorption alternative had several advantages, the operating costs were so high that the mutual's shareholders would never vote to accept them. Since the shareholders had previously voted to accept the air-stripping alternative, the boardmembers felt that another shareholders vote was not necessary.

Not all of the boardmembers from the Richwood mutual were available to attend the November meeting with EPA. Therefore, the boardmembers informed EPA that they would call a meeting of the full board at a later date to discuss the alternatives and would provide EPA with the results of that meeting. Richwood's president, Mel Huber, informed EPA in December 1985 that Richwood's boardmembers had also decided that the air-stripping configuration with the 60,000 gallon storage reservoir was their preferred IRM alternative, and that a full shareholder vote was not necessary to implement this alternative since they had previously approved air-stripping treatment. As with Rurban Homes, Richwood's boardmembers recognized the advantages of the carbon adsorption alternative, but determined that the mutuals' members would not approve it due to its high operating costs.

In November, 1984, the Pre-Design Study was provided to the board of directors of Hemlock Mutual Water Company. EPA notified Hemlock's board of directors that an upgrade to their existing treatment system could potentially be included as part of the IRM if Hemlock agreed to pay the operating costs associated with the improved system. Hemlock notified EPA that it still did not wish to participate in the IRM project.

<u>Conceptual Design of Air-Stripping Systems</u>

Based on an evaluation of the results of the Pre-Design Study, EPA's consultations with DHS, and community relations activities involving the three mutuals, EPA prepared a revised cost-effectiveness analysis of the IRM alternatives that was approved in August 1985 (U.S. EPA, 1985). EPA determined that the air-stripping system configuration that did not include the in-ground storage reservoir was not cost-effective due primarily to potential problems with system reliability. An additional consideration was the potential adverse impacts on the surrounding community, such as noise associated with 24-hour operation in a residential neighborhood. The cost of including a storage reservoir in the air-stripping system, however, made the total 5-year costs for air-stripping and carbon adsorption virtually equal. [Five years was used as the basis for comparison, because the proposed action was being taken as an initial remedial measure and its objective was to provide a supply of uncontaminated water to the mutuals in the interim before a long-term remedial action is implemented, It was expected to take approximately 5 years before a long-term remedial action is implemented.] Therefore, either treatment system alternative appeared to be potentially cost-effective, although carbon adsorption had several non-cost advantages over the air-stripping alternative. The only significant difference in cost is that air-stripping has a much higher capital cost than carbon adsorption, but significantly lower operation & maintenance (O&M) costs. This fact, however, had a large effect on the institutional feasibility of implementing the carbon adsorption alternative, since at that time, DHS planned to require the mutuals to pay for long-term O&M costs. This would have led to an increase in the average monthly water bill of the mutuals' members by over 400% which was not considered acceptable to the mutuals and therefore, not institutionally feasible. Based primarily on the institutional feasibility issue, EPA decided that the air-stripping alternative, which now included the installation of an in-ground storage reservoir, was still the cost-effective IRM alternative for Richwood and Rurban Homes.

EPA directed its contractor, CH_2M Hill, to prepare detailed conceptual designs for air-stripping systems (including storage reservoirs) for Richwood and Rurban Homes and to prepare South Coast Air Quality Management District (SCAQMD) permit applications for the two mutuals. The conceptual designs were completed and the mutuals submitted permit applications to SCAQMD in September 1985 (CH_2M Hill, 1985a, 1985b). The detailed conceptual designs did not contain any major differences from the preliminary conceptual designs of the airstripping systems included in the Pre-Design Study.

During the preparation of the detailed conceptual designs for the air-stripping systems, the level of contamination in Richwood's wells started to rise and approached 100 ppb of PCE, 20 times higher than the SNARL level of 4 ppb. Since this water was being delivered to customers for drinking and startup of the air-stripping system was at least 8 months away, DHS used state funds to pay for an emergency temporary pipeline connection from Richwood to the San Gabriel Valley Water Company. San Gabriel Valley Water Company agreed to provide water to Richwood until the IRM was implemented. The temporary connection was in place in early 1986.

Senate Bill 1063

In August of 1985, the California State Assembly began considering Senate Bill 1063 (SB 1063) that would authorize State funding for design and construction of carbon treatment systems for Richwood and Rurban Homes, as well as an upgrade to Hemlock's existing carbon adsorption system. The most significant feature of SB 1063 was that it directed DHS to pay for O&M for the carbon adsorption systems for 20 years (the design life of the treatment systems). The bill was passed by the legislature and became law in October 1985. In February 1986, DHS informed EPA that it was prepared to implement the provisions of SB 1063, including the payment for O&M on the three carbon adsorption systems. In addition, DHS has decided that it will pay for O&M of Hemlock's existing carbon adsorption system, whether or not the proposed upgrade to their system is installed.

Conceptual Design of Carbon Adsorption Systems

Since EPA's decision in August 1985 regarding the continued cost-effectiveness of implementing the air-stripping alternative was based primarily on the lack of institutional feasibility of the carbon adsorption alternative (due to the inability of the mutuals to pay the high cost of O&M of carbon adsorption systems), the passage of SB 1063 allows EPA to reconsider its decision. In anticipation of a formal reconsideration of the May 1984 Record of Decision, EPA directed its contractor, CH_2M Hill, to prepare detailed conceptual designs of the carbon adsorption alternative for the three mutuals. In addition, updated cost estimates for the air-stripping and carbon adsorption alternatives were requested. Preparing the carbon adsorption conceptual designs was to occur in parallel with the SCAQMD's modeling of estimated air emissions for the air-stripping designs as part of SCAQMD's permit approval process. This would bring the design of air-stripping and carbon adsorption systems to an equal point, so that the IRM project could be expeditiously completed regardless of which alternative EPA chose to go forward with.

In preparing detailed conceptual designs of carbon adsorption systems for the three mutuals, several significant changes were made from the preliminary conceptual designs for carbon adsorption systems that were included in the Pre-Design Study. The major changes are summarized here for the three mutuals' systems:

1) Richwood and Rurban Homes. The detailed conceptual designs are based on the assumption used during the Pre-Design Study that an empty-bed-contact-time (EBCT) of 10 minutes at peak system flow will be sufficient to achieve suitable levels of contaminant removal (EBCT = carbon bed volume / peak system flow rate).

A major change in the detailed conceptual design, however, is that it is planned to use two carbon vessels in a series configuration (i.e., the treated effluent from the first carbon bed will then be treated by the second carbon bed before distribution to the mutuals' distribution system) rather than the parallel configuration (i.e., the flow being split between the two carbon beds and each stream is treated by only one carbon bed) contemplated during the Pre-Design Study. The series configuration offers the advantages of a greater safety factor since at "breakthrough" (the time at which a noticeable increase in the contaminant concentration in the effluent occurs) for the first carbon bed, the second bed safeguards against the passing of contaminants into the distribution system. This in turn allows less frequent sampling and analysis of the system, and therefore, lower degree of required operator attention and lower operating costs. In addition, a series configuration allows flexibility in optimizing the carbon usage rate of the system, which is the most significant factor in determining the system's operating cost.

A closer analysis of the requirements for designing adequate carbon systems for the mutuals also led to the identification of two additional system components: booster pumps and dedicated backwash systems. Estimates of the pressure head loss that would occur through the carbon beds required the addition of booster pumps to the conceptual design for the carbon adsorption systems. A primary booster pump would be used to increase the water pressure before carbon treatment to maintain the current discharge pressures to the mutuals' distribution systems. A secondary booster pump would also be installed to provide standby booster capacity. It was considered prudent to include booster pumps in the design because the actual head and capacity of the mutuals' well pumps is unknown. In addition, to reduce headloss and to improve system performance, dedicated backwash systems would be installed. The backwash system would consist of a dedicated pump and a backwash storage reservoir (an in-ground reservoir would be used for Richwood's system, while an above-ground steel tank would be used for Rurban Homes). Approximately once per month, the water from the backwash storage reservoir would be pumped through the carbon vessels to expand the carbon bed. The wastewater produced during backwash of the system would be piped to a drainage sump that connects to the waste system and would flow to the storm drain system for disposal.

The addition of booster pumps to the carbon adsorption system conceptual design reduced the relative advantages that the Pre-Design Study determined carbon adsorption had as compared to air-stripping. For example, the addition of booster pumps will lead to the carbon adsorption system having a control system as complex as the air-stripping alternative without reservoir storage. The design of a simple treatment system to ensure "system reliability" is not as crucial for the carbon adsorption system, however, since DHS would operate the carbon adsorption system under SB 1063. The additional power load of the booster pumps will also increase the possibility that the carbon adsorption system could cause electrical power surges in the neighborhood as the wells cycle on and off. The power load for the carbon adsorption system, however, would be approximately half that of the air-stripping system, so that in a relative comparison, air-stripping may cause more power surges. It cannot be determined whether the added power load of the carbon adsorption or airstripping will definitely lead to electrical surges without a detailed evaluation based on information from the local power company and an analysis of the motor starting characteristics of the existing and proposed equipment. An air-stripping system, however, would have a higher probability of causing such surges due to the greater increase in cycling power load. The addition of the booster pumps will also add additional noise to the carbon adsorption syste, although again this would be relatively less of a problem than for air-stripping since the air-stripping system would have air blowers as well as booster pumps operating.

2) Hemlock. The conceptual design of an upgrade to Hemlock's existing carbon adsorption system was based on meeting the same design criteria as the conceptual designs for Richwood and Rurban Homes -- the major design criterion being achieving a 10 minute EBCT at peak flow. The peak flow of Hemlock's system was assumed to be 500 gpm, the sum of the nominal capacities of Hemlock's two well pumps. Hemlock's current carbon adsorption system is sized to treat a peak flow of 360 gpm with an EBCT of 5 minutes. Although limited pilot testing by Hemlock has shown that a 5-minute EBCT is sufficient to treat the current level of contamination of Hemlock's wells, the system does not have the same normal safety factor built into its design as in the conceptual designs for Richwood and Rurban Homes. This is a concern since higher levels of contamination occur in other nearby wells and have occurred in Hemlock's wells in the past. Also, Hemlock operates its system with a flow restrictor to ensure that the peak flow is not greater than 360 gpm, which would lead to an EBCT of less than 5 minutes. This has led to some problems with maintaining adequate pressure in Hemlock's distribution sytem. Although a peak flow of 500 gpm was assumed during the conceptual design of an upgrade to Hemlock's existing treatment system, a more accurate estimate of Hemlock's peak flow would have to be obtained before the final design of an upgrade to their existing treatment system could be prepared. In addition, for the purposes of the conceptual design and cost estimates, a more recent estimate for Hemlock's average flow of 150 gpm was used.

EPA's contractor, CH_2M Hill, evaluated 2 major sub-alternative methods of upgrading Hemlock's existing carbon adsorption system: 1) dedicating Hemlock's existing system (with minor modifications) to treating the discharge from Hemlock's North well and installing a separate system to treat the discharge from the South well; and 2) dismantling the existing carbon adsorption system and installing a new system sized to treat the entire 500 gpm peak flow. The second subalternative conceptual design has the option of including a dedicated backwash storage and pumping system (as in the Richwood and Rurban Homes conceptual designs) or operating as Hemlock's current system operates with the effluent from one of the carbon vessels being used to backwash the other vessel. In general, the first subalternative has the advantage of lower initial capital cost, however, the second subalternative offers greater ease of system operation and lower O&M costs. The relative advantages and disadvantages of the two system upgrade subalternatives are discussed in more detail in the conceptual design report, Evaluation of Alternatives for Hemlock Mutual Water Company Activated Carbon System Expansion, June 19, 1986 (CH_2M Hill, 1986e). The specific alternative method of upgrading Hemlock's existing carbon adsorption treatment system to be used would be determined during remedial design of the IRM.

The conceptual designs and cost estimates for carbon adsorption systems for Richwood and Rurban Homes, and for alternative methods of upgrading Hemlock's existing carbon adsorption systems were completed in June 1986 (CH_2M Hill, 1986c, 1986d, 1986e). In addition, the cost estimates for the air-stripping alternative were also updated in June 1986 (CH_2M Hill, 1986b).

IV. Cost Revisions

As discussed previously, CH_2M Hill had developed revised cost estimates during the Pre-Design Study for air-stripping and carbon adsorption treatment systems for the Richwood and Rurban Homes Mutual Water companies. For air-stripping systems, costs were developed for two distinct treatment system configurations--with and without a storage reservoir. The cost estimates for carbon adsorption and for the air-stripping configuration with the storage reservoir for Richwood and Rurban Homes, and for alternative methods of upgrading Hemlock's existing carbon adsorption system were updated in June 1986 after detailed conceptual designs were prepared. An updated cost estimate for the air-stripping configuration that doesn't include a storage reservoir and air-stripping alternative cost estimates for Hemlock were derived from June 1986 cost estimates for the air-stripping configuration that included a storage reservoir prepared for Richwood and Rurban Homes as explained in the following section.

In addition, since the flow rate study conducted as part of the Pre-Design Study developed estimated flow rates for Richwood and Rurban Homes that are significantly higher than the estimated flow rates used in the FFS, cost estimates for the other potentially feasible IRM alternatives have been revised based on the most recent flow rate estimates for those mutuals. A more recent estimate of Hemlock's average flow rate has also been used in revising the cost estimates for the IRM alternatives.

Table 1 summarizes the revised cost estimates for the IRM alternatives. Table 1 and the following discussion excludes two alternatives which were identified in the FFS and the Record of Decision: 1) mutuals obtain water from a nearby water purveyor while maintaining their water rights; and 2) mutuals obtain water from a nearby water purveyor while leasing their water rights to the purveyor. These two alternatives have been deleted from further consideration at this time since no nearby water purveyor has been identified that would agree to provide water to the mutuals under either of these arrangements, except in the case of Richwood where San Gabriel Valley Water Company agreed to provide water on an emergency temporary basis until the IRM could be implemented.

The costs summarized in Table 1 have been calculated for each of the alternatives based on the following assumptions:

- 5 year operation (since it is estimated that a final remedial action will be implemented by that time),
- 10% discount factor in the present worth analysis, and
- revised estimates of well flow rates as determined during the Pre-Design Study, as well as a more recent estimate of Hemlock's system's average flow rate.

An evaluation of the current estimated costs in comparison with the December 1983 costs estimated in the FFS is presented in the following pages.

ALTERNATIVE 1: Air-Stripping Treatment

December 1983 Estimate: Air-stripping treatment system capital and operating cost estimates are taken from the FFS prepared by CH_2M Hill (CH_2M Hill, 1983). Operating costs do not include the cost of periodic water sample analyses to ensure successful removal of contaminants by the treatment system.

June 1986 Estimate: Capital and operating costs for the air-stripping system configuration which includes a storage reservoir for Richwood and Rurban Homes were developed by CH_2M Hill (CH_2M Hill, 1986b) based on the detailed conceptual designs completed in September 1985 (CH_2M Hill, 1985a, 1985b). A higher capital cost allowance for equipment installation and reservoir construction has been included in the cost estimates for the Richwood mutual to allow for additional construction costs associated with installing a treatment system in such a small well site (Richwood's well site is much smaller than Rurban Homes). For Hemlock, the cost estimate from Richwood has been used with minor modifications. The cost estimate for Richwood is assumed to be fairly accurate for Hemlock for several reasons. First, both systems operate in the same manner with two wells, a hydropneumatic tank, and a constant cycling on and off of the wells to maintain system pressure. The average system flow rate of Hemlock is 150 gpm as compared to 170 gpm for Richwood and 210 for Rurban Homes. Hemlock's well site is also very similar to Richwood's in that it is very small and narrow. Therefore, the higher capital cost allowances for equipment installation and reservoir construction used in the Richwood cost estimate are expected to be more accurate in Hemlock's situation than the lower cost allowances in the Rurban Homes estimate. The cost of piping for Hemlock, however, was based on the estimate for Rurban Homes ($20,000) rather than Richwood ($50,000) because the additional cost for Richwood is associated with installing a pipe connection from Richwood's South well (located at a different well site from the where the North well is and where the treatment system would be installed) to the North well site.

Capital costs have also been revised to include an allowance (15% of capital cost subtotal) for management services during construction. This cost element was not identified as a separate cost element during the FFS, but would be included in EPA's implementation of the IRM. Operating costs have been revised to include the cost of water sampling and analysis to monitor treatment system performance and to add a contingency for operating costs. These cost elements were also not included in the FFS cost estimates.

Estimates for the air-stripping configuration that does not include the storage reservoir were developed by subtracting the cost of the storage reservoir from the cost estimates for the air-stripping configuration that included the storage reservoir, and subtracting the associated capital cost allowances for contingency; engineering, legal and administrative fees; and management services during construction.

A. Air-Stripping: Rurban Homes Mutual Water Company.

	December 1983 Estimate	June 1986 Estimate	Difference
CAPITAL COST			
Towers with packing	$ 49,000	$ 86,000	
Fans	8,000	5,000	
Pumps	16,000	20,000	
Piping	4,000	20,000[1]	
Chlorine System	10,000	12,500[2]	
Equipment installation	61,000	75,000	
Overflow Piping	*	25,000	
Electrical	*	80,000	
Soundproofed Bldg.	*	20,000	
Mobilization & site preparation	*	20,000	
Subtotal without reservoir	$ 148,000	$ 363,000	
Contingency	44,000	109,000	
Engineering, legal, & administrative fees	23,000	54,000	
Management services during construction	***	54,000	
Total without reservoir	$ 215,000	$ 580,000	$ 365,000
Subtotal without reservoir	**	$ 363,000	
60,000 gallon reservoir	**	150,000	
Subtotal with reservoir	**	$ 513,000	
Contingency	**	154,000	
Engineering, legal, & administrative fees	**	77,000	
Management services during construction	**	77,000	
Total with reservoir	**	$ 821,000	**
ANNUAL OPERATING COST			
Power	*	$ 8,500	
Maintenance	*	10,000	
Sampling and Analysis cost	***	12,000	
Subtotal--annual operating cost	$ 17,400	$ 30,500	
contingency	***	9,000	
Total annual operating cost	$ 17,400	$ 39,500	$ 22,100
5-YEAR PRESENT WORTH OPERATING COST	$ 66,000	$ 150,000	$ 84,000
TOTAL 5-YEAR PRESENT WORTH COSTS			
° WITHOUT RESERVOIR	$ 281,000	$ 730,000	$ 449,000
° WITH RESERVOIR	**	$ 971,000	**

* This cost element was not broken out as a separate cost category in the December 1983 FFS.

** This system configuration (with storage reservoir) was not considered in the December 1983 FFS.

*** These cost elements were not included in the estimates of annual operating costs in the December 1983 FFS.

1) This cost element in the June 1986 cost estimate combines the cost of piping, valves, and instrumentation.

2) This cost element in the June 1986 cost estimate combines the cost of treated water chlorination with the cost of tower disinfection.

B. Air-Stripping: Richwood Mutual Water Company.

	December 1983 Estimate	June 1986 Estimate	Difference
CAPITAL COST			
Towers with packing	$ 39,000	$ 86,000	
Fans	4,000	5,000	
Pumps	14,000	20,000	
Piping	3,000	50,000[1]	
Chlorine System	10,000	12,500[2]	
Equipment installation	49,000	125,000	
Overflow Piping	*	25,000	
Electrical	*	80,000	
Soundproofed Bldg.	*	20,000	
Mobilization & site preparation	*	20,000	
Subtotal without reservoir	$ 119,000	$ 443,000	
Contingency	36,000	133,000	
Engineering, legal, & administrative fees	18,000	66,000	
Management services during construction	***	66,000	
Total without reservoir	$ 173,000	$ 708,000	$ 535,000
Subtotal without reservoir	**	$ 443,000	
60,000 gallon reservoir	**	200,000	
Subtotal with reservoir	**	$ 643,000	
Contingency	**	194,000	
Engineering, legal, & administrative fees	**	97,000	
Management services during construction	**	97,000	
Total with reservoir	**	$ 1,031,000	**
ANNUAL OPERATING COST			
Power	*	$ 7,000	
Maintenance	*	10,000	
Sampling and Analysis cost	***	12,000	
Subtotal--annual operating cost	$ 13,200	$ 29,000	
contingency	***	8,700	
Total annual operating cost	$ 13,200	$ 37,700	$ 24,500
5-YEAR PRESENT WORTH OPERATING COST	$ 50,000	$ 143,000	$ 93,000
TOTAL 5-YEAR PRESENT WORTH COSTS			
° WITHOUT RESERVOIR	$ 223,000	$ 851,000	$ 628,000
° WITH RESERVOIR	**	$ 1,174,000	**

* This cost element was not broken out as a separate cost category in the December 1983 FFS.

** This system configuration (with storage reservoir) was not considered in the December 1983 FFS.

*** These cost elements were not included in the estimates of annual operating costs in the December 1983 FFS.

1) This cost element in the June 1986 cost estimate combines the cost of piping, valves, and instrumentation.

2) This cost element in the June 1986 cost estimate combines the cost of treated water chlorination with the cost of tower disinfection.

C. Air-Stripping: Hemlock Mutual Water Company.

	December 1983 Estimate	June 1986 Estimate	Difference
CAPITAL COST			
Towers with packing	$ 24,000	$ 86,000	
Fans	4,000	5,000	
Pumps	14,000	20,000	
Piping	3,000	20,000[1]	
Chlorine System	10,000	12,500[2]	
Equipment installation	39,000	125,000	
Overflow Piping	*	25,000	
Electrical	*	80,000	
Soundproofed Bldg.	*	20,000	
Mobilization & site preparation	*	20,000	
Subtotal without reservoir	$ 94,000	$ 413,000	
Contingency	28,000	124,000	
Engineering, legal, & administrative fees	15,000	62,000	
Management services during construction	***	62,000	
Total without reservoir	$ 137,000	$ 661,000	$ 524,000
Subtotal without reservoir	**	$ 413,000	
60,000 gallon reservoir	**	200,000	
Subtotal with reservoir	**	$ 613,000	
Contingency	**	184,000	
Engineering, legal, & administrative fees	**	92,000	
Management services during construction	**	92,000	
Total with reservoir	**	$ 981,000	**
ANNUAL OPERATING COST			
Power	*	$ 7,000	
Maintenance	*	10,000	
Sampling and Analysis cost	***	12,000	
Subtotal--annual operating cost	$ 10,800	$ 29,000	
contingency	***	8,700	
Total annual operating cost	$ 10,800	$ 37,700	$ 26,900
5-YEAR PRESENT WORTH OPERATING COST	$ 41,000	$ 143,000	$ 102,000
TOTAL 5-YEAR PRESENT WORTH COSTS			
° WITHOUT RESERVOIR	$ 178,000	$ 804,000	$ 626,000
° WITH RESERVOIR	**	$ 1,124,000	**

* This cost element was not broken out as a separate cost category in the December 1983 FFS.

** This system configuration (with storage reservoir) was not considered in the December 1983 FFS.

*** These cost elements were not included in the estimates of annual operating costs in the December 1983 FFS.

1) This cost element in the June 1986 cost estimate combines the cost of piping, valves, and instrumentation.

2) This cost element in the June 1986 cost estimate combines the cost of treated water chlorination with the cost of tower disinfection.

D. Combined Cost of Air-Stripping for the Three Mutuals.

	December 1983 Estimate	June 1986 Estimate	Difference
CAPITAL COST			
Towers with packing	$ 112,000	$ 258,000	
Fans	16,000	15,000	
Pumps	44,000	60,000	
Piping	10,000	90,000[1]	
Chlorine System	30,000	37,500[2]	
Equipment installation	149,000	325,000	
Overflow Piping	*	75,000	
Electrical	*	240,000	
Soundproofed Bldg.	*	60,000	
Mobilization & site preparation	*	60,000	
Subtotal without reservoir	$ 361,000	$ 1,219,000	
Contingency	108,000	366,000	
Engineering, legal, & administrative fees	56,000	182,000	
Management services during construction	***	182,000	
Total without reservoir	$ 525,000	$ 1,949,000	$ 1,424,000
Subtotal without reservoir	**	$ 1,219,000	
60,000 gallon reservoir	**	550,000	
Subtotal with reservoir	**	$ 1,769,000	
Contingency	**	532,000	
Engineering, legal, & administrative fees	**	266,000	
Management services during construction	**	266,000	
Total with reservoir	**	$ 2,833,000	**
ANNUAL OPERATING COST			
Power	*	$ 22,500	
Maintenance	*	30,000	
Sampling and Analysis cost	***	36,000	
Subtotal--annual operating cost	$ 41,400	$ 88,500	
contingency	***	26,400	
Total annual operating cost	$ 41,400	$ 114,900	$ 73,500
5-YEAR PRESENT WORTH OPERATING COST	$ 157,000	$ 436,000	$ 279,000
TOTAL 5-YEAR PRESENT WORTH COSTS			
° WITHOUT RESERVOIR	$ 682,000	$ 2,385,000	$ 1,703,000
° WITH RESERVOIR	**	$ 3,269,000	**

* This cost element was not broken out as a separate cost category in the December 1983 FFS.

** This system configuration (with storage reservoir) was not considered in the December 1983 FFS.

*** These cost elements were not included in the estimates of annual operating costs in the December 1983 FFS.

1) This cost element in the June 1986 cost estimate combines the cost of piping, valves, and instrumentation.

2) This cost element in the June 1986 cost estimate combines the cost of treated water chlorination with the cost of tower disinfection.

ALTERNATIVE 2: Carbon Adsorption Treatment

December 1983 Estimate: Carbon adsorption treatment system capital and operating cost estimates are taken from the FFS prepared by CH_2M Hill (CH_2M Hill, 1983). Operating costs do not include the cost of periodic water sample analyses to ensure successful removal of contaminants by the treatment system.

June 1986 Estimate: Capital and operating costs for carbon adsorption have been updated and are taken from the conceptual designs for carbon adsorption systems prepared by EPA's contractor, CH_2M Hill in June 1986 (CH_2M Hill, 1986c, 1986d, 1986e). A much higher contingency allowance (50% as opposed to 10% in the FFS) has been included in the estimates to reflect the potential construction problems associated with installing treatment systems in such small area well sites, and the uncertainty in final system design for the carbon adsorption alternative until pilot testing is completed. This is higher than the contingency allowance used for air-stripping (30%) because there are relatively less "unknowns" for the cost of air-stripping than for the cost of carbon adsorption. In addition, an allowance (15% of capital cost subtotal) has been added for management services during construction. This cost element was not included in the FFS.

A range of capital and operating costs for an upgrade to Hemlock's existing carbon adsorption system is presented. The range is based on the different subalternative methods of upgrading Hemlock's existing system as outlined in the June 1986 CH_2M Hill conceptual design for Hemlock (CH_2M Hill, 1986e). The subtotals and total cost figures presented do not equal the sum of the ranges of the different cost elements because the different subalternatives have higher costs for some cost categories, but lower costs in others. For each cost category, the entire range of cost estimates for the Hemlock subalternatives is presented.

The estimated operating costs for carbon adsorption have been revised and are now an order of magnitude higher than the estimate in the FFS. This large increase in estimated operating costs is due to several factors. First, the FFS cost estimates were based on estimates of the carbon usage rate that were derived from experimental data. The estimates in the Pre-Design Study are based on more recent information regarding actual carbon usage rates for existing carbon adsorption systems treating water contaminated with low levels of organic compounds. These actual carbon usage rates are much higher than the estimated usage rates based on experimental data. The second factor contributing to the increase in the operating cost estimate is the revised estimates of the mutuals' well flow rates. Since the operating cost of a carbon adsorption system is approximately directly proportional to the amount of water treated, the higher flow estimates lead to increased operating costs. Finally, operating cost estimates now include the cost of water sampling and analysis to monitor treatment system performance, as well as a contingency allowance (again a high -- 50% -- allowance was used to reflect the uncertainty in actual system performance). These cost components were not included in the operating cost estimates in the FFS.

A. Carbon Adsorption: Rurban Homes Mutual Water Company.

	December 1983 Estimate	June 1986 Estimate	Difference
CAPITAL COST			
Equipment purchase & installation; carbon vessels with face piping & internals	$ 287,000[1]	$ 184,000	
Chlorination system	$ 10,000	2,500	
Installation	$ 178,000	***	
Backwash storage	**	26,500	
Pumps	**	26,500	
Site piping, valves, and instrumentation	*	34,000	
Backwash discharge piping	**	49,000	
Electrical	**	44,000	
Mobilization & site preparation	*	15,000	
Subtotal	$ 475,000	$ 381,500	
Contingency	48,000	191,000	
Engineering, legal & administrative fees	63,000	57,300	
Management services during construction	**	57,300	
Total	$ 586,000	$ 687,100	$ 101,000
ANNUAL OPERATING COST			
Activated Carbon	*	$ 49,500	
Maintenance	*	7,600	
Sampling and analysis	**	12,000	
Power	**	2,000	
Subtotal	$ 10,500	$ 71,100	
Contingency	**	35,500	
Total annual operating cost	$ 10,500	$ 106,600	$ 96,100
5-YEAR PRESENT WORTH OPERATING COST	$ 40,000	$ 404,000	$ 364,000
TOTAL 5-YEAR PRESENT WORTH COSTS	$ 626,000	$ 1,091,100	$ 465,100

* This cost element was not broken out as a separate cost category in the December 1983 FFS.

** This cost element was not identified in the December 1983 FFS.

*** This cost element was not broken out as a separate cost category in the June 1986 cost estimate.

1) This cost element includes the cost of the carbon vessels and associated piping, and the initial charge of activated carbon.

B. Carbon Adsorption: Richwood Mutual Water Company.

	December 1983 Estimate	June 1986 Estimate	Difference
CAPITAL COST			
Equipment purchase & installation; carbon vessels with face piping & internals	$ 195,000[1]	$ 167,000	
Chlorination system	$ 10,000	2,500	
Installation	$ 123,000	***	
Backwash storage	**	50,000	
Pumps	**	28,000	
Site piping, valves, and instrumentation	*	58,000	
Backwash discharge piping	**	11,000	
Electrical	**	44,000	
Mobilization & site preparation	*	20,000	
Subtotal	$ 328,000	$ 380,500	
Contingency	33,000	190,000	
Engineering, legal & administrative fees	43,000	57,000	
Management services during construction	**	57,000	
Total	$ 404,000	$ 684,500	$ 280,500
ANNUAL OPERATING COST			
Activated Carbon	*	$ 40,500	
Maintenance	*	7,500	
Sampling and analysis	**	12,000	
Power	**	2,000	
Subtotal	$ 8,700	$ 62,000	
Contingency	**	31,000	
Total annual operating cost	$ 8,700	$ 93,000	$ 84,300
5-YEAR PRESENT WORTH OPERATING COST	$ 33,000	$ 352,000	$ 319,000
TOTAL 5-YEAR PRESENT WORTH COSTS	$ 437,000	$ 1,036,500	$ 599,500

* This cost element was not broken out as a separate cost category in the December 1983 FFS.

** This cost element was not identified in the December 1983 FFS.

*** This cost element was not broken out as a separate cost category in the June 1986 cost estimate.

1) This cost element includes the cost of the carbon vessels and associated piping, and the initial charge of activated carbon.

C. Carbon Adsorption: Hemlock Mutual Water Company.

CAPITAL COST	December 1983 Estimate	June 1986 Estimate[1]	Difference[1]
Equipment purchase & installation; carbon vessels with face piping & internals	$ 132,000[2]	107,400-138,500	
Chlorination system	$ 10,000	***	
Installation	$ 85,000	16,400-17,600	
Tin-in piping & valves	**	$ 3,200-3,500	
Foundation	**	3,300-5,000	
Mobilization & site preparation	*	5,200-8,600	
Backwash reservoir & pump	**	0-52,500	
Subtotal	$ 227,000	$ 135,800-225,400	
Salvage Value	**	(5,700)-0	
Contingency	23,000	67,900-112,700	
Engineering, legal & administrative fees	30,000	20,400-33,900	
Management services during construction	**	20,400-33,900	
Total	$ 280,000	$ 244,500-400,200	$ (35,500)-120,200
ANNUAL OPERATING COST			
Activated Carbon	*	$ 36,000	
Maintenance	*	3,500-5,500	
Sampling	**	12,000-24,000	
Power	**	3,000-3,500	
Subtotal	$ 17,700	$ 54,500-69,000	
Contingency	**	27,300-34,500	
Total annual operating cost	$ 17,700	$ 81,800-103,500	$ 64,100-85,800
5-YEAR PRESENT WORTH OPERATING COST	$ 67,000	$ 310,000-392,000	$ 243,000-325,000
TOTAL 5-YEAR PRESENT WORTH COSTS	$ 347,000	$ 615,700-716,200	$ 268,700-369,200

* This cost element was not broken out as a separate cost category in the December 1983 FFS.

** This cost element was not identified in the December 1983 FFS.

*** This cost element was not identified in the June 1986 cost estimate.

1) The range of cost figures presented represents the difference in costs depending on which subalternative method of upgrading Hemlock's existing system is implemented. The subtotals and total cost figures do not equal the sum of the ranges of the different cost elements because the different subalternatives have higher costs for some cost categories, but lower costs in others.

2) This cost element includes the cost of the carbon vessels and associated piping, and the initial charge of activated carbon.

D. Combined Cost of Carbon Adsorption for the Three Mutuals.

	December 1983 Estimate	June 1986 Estimate[1]	Difference[1]
CAPITAL COST			
Subtotal of primary capital cost elements	$ 1,030,000	$ 897,800-984,000	
Salvage	**	(5,700)-0	
Contingency	104,000	387,000-432,700	
Engineering, legal, and administrative fees	136,000	134,700-148,200	
Management services during construction	**	134,700-148,200	
Total	$ 1,270,000	$ 1,616,000-1,772,000	$ 346,000-502,000
ANNUAL OPERATING COST			
Activated Carbon	*	$ 126,000	
Maintenance	*	18,600-20,600	
Sampling	**	36,000-48,000	
Power	**	7,000-7,500	
Subtotal	$ 36,900	$ 187,600-202,100	
Contingency	**	93,800-101,000	
Total annual operating cost	$ 36,900	$ 281,400-303,100	$ 244,500-266,200
5-YEAR PRESENT WORTH OPERATING COST	$ 140,000	$ 1,066,000-1,148,000	$ 926,000-1,008,000
TOTAL 5-YEAR PRESENT WORTH COSTS	$ 1,410,000	$ 2,743,000-2,844,000	$ 1,333,000-1,434,000

* This cost element was not broken out as a separate cost category in the December 1983 FFS.

** This cost element was not identified in the December 1983 FFS.

1) The range of cost figures presented represents the difference in costs depending on which subalternative method of upgrading Hemlock's existing system is impelemented. The total cost figures do not equal the sum of the ranges of the different cost elements because the different subalternatives have higher costs for some cost categories, but lower costs in others.

ALTERNATIVE 3: Mutuals Connect to the Metropolitan Water District

December 1983 Estimate: Capital and operating costs are taken from the FFS prepared by CH_2M Hill (CH_2M Hill, 1983). The capital costs for this alternative were not broken down per mutual since one reservoir facility would service all three mutuals. Therefore, the capital costs are shown in the following table as presented in the FFS.

June 1986 Estimate: Increased water costs to the mutuals under this alternative have been revised based on the new estimates of Rurban Homes and Richwood's well flow rates developed by CH_2M Hill during the Pre-Design Study (CH_2M Hill, 1984), as well as a more recent estimate of Hemlock's average flow rate (CH_2M Hill, 1986e). In addition, the current cost of uninterruptible, treated water provided by the Metropolitan Water District (MWD) during the 1985-1986 fiscal year has been used ($224 per acre-foot). The cost of MWD water is assumed to be constant over the 5-year period of the IRM although it is estimated that MWD water rates will increase at 10% per year for the next five years (CH_2M Hill, 1986a). Water costs are calculated as the difference between present water rates and projected water rates if water is purchased from MWD.

This alternative, as outlined in the FFS, included a 200,000 gallon storage reservoir which would be used by Richwood, Rurban Homes, and Hemlock mutuals. The capital cost estimates for the system components used in the FFS are still used in this estimate as well. However, the contingency allowance included in the revised cost estimate has been increased. In the FFS, a small (approximately 12%) contingency was included, but was only applied to the capital costs associated with the reservoir, not the feeder connection and main pipeline costs. In the revised cost estimate, a 50% contingency allowance has been included and is applied to all of the capital cost elements. The contingency has been increased due to several reasons. First, the original reservoir and pipeline system cost estimate was based on a required daily water use of 464,000 gallons per day. The current estimate of the daily water demand of the three mutuals is 763,000 gallons per day -- 64% higher than estimated during the FFS. Therefore, the size of the reservoir and possibly the pipelines will have to be larger than contemplated during the FFS. Second, to implement this alternative an appropriate location for the reservoir would have to be identified. Depending on the location selected, the cost of land may vary. In addition, the cost of the main pipeline is dependent on the reservoir location since its location will determine the length of the main pipeline. Since a location has not been specifically identified, inclusion of a large contingency allowance is warranted. Third, 2 1/2 years have passed since the original cost estimates, and therefore, construction costs are probably higher. In fact, as measured by the construction cost index of Engineering News Record, construction costs have increased by over 20% over this period. For similar reasons, a 50% contingency factor has also been applied to the operation and maintenance costs.

An estimate for engineering, legal, and administrative fees and for management services during construction have also been included in the revised cost estimates. These costs were not included in the FFS, although they would be incurred during procurement of land for the reservoir and during the design and construction of the reservoir and associated pipelines.

Combined Costs of Connecting to the Metropolitan Water District for Richwood, Rurban Homes, and Hemlock Mutual Water Companies.

	December 1983 Estimate	June 1986 Estimate	Difference
CAPITAL COST			
200,000 gallon storage tank	$ 140,000	$ 140,000	
Land	130,000	130,000	
Pump Station	150,000	150,000	
Feeder connection & main pipeline	730,000	730,000	
Connection to mutuals	36,000	36,000	
Subtotal	$ 1,186,000	$ 1,186,000	$ 0
Contingency	50,000	593,000	
Engineering, Legal, & administrative fees	*	178,000[1]	
Management services during construction	*	178,000[1]	
Total Capital Costs	$ 1,236,000	$ 2,135,000	$ 899,000
5-YEAR PRESENT WORTH OPERATION & MAINTENANCE COSTS	$ 50,000	$ 75,000	$ 25,000
ANNUAL INCREASED WATER COSTS	$ 94,000	$ 119,000	$ 25,000
5-YEAR PRESENT WORTH INCREASED WATER COSTS	$ 348,000	$ 451,000	$ 103,000
TOTAL 5-YEAR PRESENT WORTH COSTS	$ 1,634,000	$ 2,661,000	$ 1,027,000

* This cost element was not included in the cost estimates in the December 1983 FFS.

1) This cost element has been estimated as 15% of the identifiable capital costs associated with the construction of the storage reservoir.

ALTERNATIVE 4: Mutuals Dissolve and Join With Another Water Company.

December 1983 Estimate: Costs for this alternative are taken from the FFS prepared by CH_2M Hill (CH_2M Hill, 1983).

June 1986 Estimate: Connection costs for this alternative have been revised based on more recent estimates of the number of connections in each of the mutuals' systems -- a total of 755 connections for all three mutuals compared with an estimate of 693 used in the FFS. Increased water costs to the mutuals under this alternative have been revised based on the new estimates of Rurban Homes and Richwood's well flow rates developed by CH_2M Hill during the Pre-Design Study (CH_2M Hill, 1984), as well as a more recent estimate of Hemlock system's average flow rate (CH_2M Hill, 1986e). The revised estimate of the number of connections in the mutuals' systems also affected the estimate of increased water costs. Water costs are calculated as the difference between present water rates and estimated water rates for receiving water from the San Gabriel Valley Water Company, as stated in the FFS.

Combined Costs for Richwood, Rurban Homes, and Hemlock Mutual Water Companies to Join With Another Water Company

	December 1983 Estimate	June 1985 Estimate	Difference
ONE-TIME CONNECTION COSTS	$ 190,000	$ 202,000	$ 12,000
ANNUAL INCREASED WATER COSTS	$ 84,000	$ 138,000	$ 54,000
5-YEAR PRESENT WORTH INCREASED WATER COSTS	$ 316,000	$ 522,000	$ 206,000
TOTAL 5-YEAR PRESENT WORTH COSTS	$ 506,000	$ 724,000	$ 218,000

ALTERNATIVE 5: Provide Bottled Water to the Mutuals' Customers.

December 1983 Estimate: Costs for this alternative are taken from the FFS prepared by CH_2M Hill (CH_2M Hill, 1983).

June 1986 Estimate: Costs have been calculated as during the FFS based on providing 10 gallons per day of bottled water per household for each mutual. Costs have been revised based on more recent estimates of the number of connections in each of the mutuals' systems -- a total of 755 connections for all three mutuals compared with an estimate of 693 used in the FFS.

Combined Cost for Providing Bottled Water to Richwood, Rurban Homes, and Hemlock Mutual Water Companies

	December 1983 Estimate	June 1986 Estimate	Difference
ANNUAL COST OF PROVIDING BOTTLED WATER	\$ 2,534,000	\$ 2,759,000	\$ 225,000
5-YEAR PRESENT WORTH COST OF PROVIDING BOTTLED WATER	\$ 9,594,000	\$ 10,459,000	\$ 865,000

Increased Water Costs to Mutuals

One consequence of the revised cost estimates for the IRM alternatives which have been summarized is that the relative economic impact each alternative will have on the mutuals' members has been changed. As discussed previously, DHS had developed a policy that required that the mutuals assume responsibility for operation and maintenance of the IRM. The passage of SB 1063 and DHS's decision to implement its provisions changed this policy with respect to the carbon adsorption alternative. If this alternative is implemented, there will be no significant economic impact on the mutuals members. This is also true for the bottled water alternative since EPA and DHS would pay for bottled water. However, the high O&M costs and increased water costs associated with the other alternatives will cause a large increase in the mutual members' water bills if those alternatives are implemented. The average water bill for a member of the mutuals is estimated at $7-9 per month. The table below summarizes the estimated estimated average increase in the mutuals' monthly household water bills for the three alternatives that would cause the mutuals' members' water bills to rise.

AVERAGE MONTHLY INCREASE IN MUTUAL MEMBERS' WATER BILLS

	Air-Stripping		Connect to MWD		Join With Another Water Company	
Mutual	Average[1] Increase for Member	Average[2] Percent Increase	Average[1] Increase for Member	Average[2] Percent Increase	Average[1] Increase for Member	Average[2] Percent Increase
Rurban Homes	$ 11	140%	$ 13	170%	$ 15	190%
Richwood	$ 14	180%	$ 16	200%	$ 17	220%
Hemlock	$ 13	160%	$ 11	140%	$ 13	170%

1) Based on the following number of households per mutual:
   Richwood--217 households,
   Rurban Homes--298 households.
   Hemlock--240 households
2) Based on an estimated existing average monthly bill of $8 per household.

As the table shows, several of the IRM alternatives will lead to large increases in the mutuals' customers' average monthly water bills. Of the three alternatives that would increase the mutuals' water bills, even the alternative with the lowest annual costs associated with it (air-stripping) will cause an estimated increase in the average household monthly water bill of up to 180% for the Richwood mutual. At the other extreme, the alternative under which the mutuals join another water company would lead to an increase of as much as 220% in Richwood's average household water bill. Although the annual O&M costs of the carbon adsorption alternative would lead to increases as high as 440% in the mutuals' average monthly water bills if the mutuals were paying for O&M, under the provisions of SB 1063 the State will fund the O&M costs for the carbon adsorption alternative, and therefore implemenation of this alternative will not affect the water bills of the mutuals' customers in any way.

These estimated increased costs to the mutuals for providing clean water have a large impact on the acceptability of the different alternatives to the affected community, which in turn affects the institutional feasibility of the alternatives. In this situation, to be institutionally feasible an alternative must be approved by the mutuals prior to implementation. An alternative that would lead to major increases in monthly water bills is unlikely to be approved by the mutuals, in which case the alternative could not be implemented. This was the primary reason behind EPA's decision to proceed with the design of the air-stripping alternative even after the results of the Pre-Design study showed that the cost of carbon adsorption was roughly equal to the cost of air-stripping (on a 5-year basis). It was not institutionally feasible to implement the carbon adsorption alternative when it would have led to five-fold increases in the mutuals' average household water bills.

V. Cleanup Criteria

The Superfund Amendments and Reauthorization Act of 1986 (SARA) §121(d)(2)(A) requires Superfund remedial actions conducted under §104 and §106 to comply with applicable or relevant and appropriate requirements, standards, criteria, or limitations (ARARs). ARARs include any standard, requirement, criteria, or limitation under any Federal environmental law, as well as any promulgated standard, requirement, criteria, or limitation under a State or facility siting law that is more stringent than any Federal standard, requirement, criteria, or limitation.

Section 121(b) of SARA requires selection, to the maximum extent practicable, of remedial actions that utilize permanent solutions and alternative treatment technologies that will result in a permanent and significant decrease in the toxicity, mobility, or volume of the hazardous substance, pollutant, or contaminant.

This section is a discussion of the issues associated with compliance with Section 121 of SARA.

Objective of the IRM

The objective of the IRM, as described in the May 1984 Record of Decision, was to ensure that all residents affected by ground water contamination in San Gabriel Area 1 are provided with a drinking water supply that is below the EPA Suggested No Adverse Response Level (SNARL) for a 10^{-6} cancer risk level for PCE -- 4 parts per billion (ppb) [Note that this level was rounded up from the actual SNARL level of 3.5 ppb.] This level is equal to California DHS's "Action Level" for PCE which is the level at which DHS recommends that the water purveyor take some action to lower the concentration of PCE in drinking water.

The applicable Federal environmental statute is the Safe Drinking Water Act. Under this law, EPA establishes drinking water regulations for contaminants through a two-step process. First, EPA promulgates health-based levels termed Maximum Contaminant Level Goals (MCLG, previously called Recommended Maximum Contaminant Levels, or RMCL) under the Safe Drinking Water Act Amendments of 1986. MCLGs are set at levels at which no adverse public health effects would occur and are set at zero for known or probable carcinogens, since there is no safe level of exposure to a carcinogen. MCLGs are unenforceable health goals -- public water supply systems are not required to meet them in water they deliver to their customers. EPA then establishes Maximum Contaminant Levels (MCL) taking into account the availability, cost, and technical feasibility of water treatment technologies that can be used to reduce the concentrations of the contaminant in public water supplies. MCLs are enforceable standards that must be met by public water supply systems. In June 1984, EPA proposed establishing a RMCL of 0 for PCE since it was considered to be a carcinogen. EPA has not yet promulgated a final MCLG for PCE, nor has it proposed a MCL. Therefore, in accordance with the EPA "Interim Guidance on Compliance with Applicable or Relevant and Appropriate Requirements" (OSWER No. 9234.0-05), the cleanup level should be selected based on chemical specific health advisory levels such that the total risk of all contaminants falls within the acceptable risk range of 10^{-4} to 10^{-7}.

Therefore, the cleanup objective of the IRM should be set based on the PCE health advisory, while also taking into consideration other Federal and State criteria, advisories, and guidance. Health advisories issued by the EPA Office of Drinking Water. The SNARL level for PCE (4 ppb) that was used in the 1984 Record of Decision was considered the health advisory for PCE at that time by the Office of Drinking Water and is also the California DHS "Action Level", which is an unenforceable health goal and is the level at which DHS recommends taking corrective action to lower the contaminant level in drinking water. The carcinogenic risk estimate used to establish the SNARL was developed by the National Academy of Sciences (NAS) in its Drinking Water and Health study. In September 1985, the Office of Drinking Water issued a new draft health advisory for PCE that included revised cancer risk estimates for exposure to PCE in drinking water that were developed by EPA's Carcinogen Assessment Group (CAG). The new health advisory for PCE estimates that the concentration equivalent to a 10^{-6} cancer risk level is 0.7 ppb. This compares with a concentration of 3.5 ppb that the NAS study determined was equivalent to a 10^{-6} cancer risk level (which was rounded to 4 ppb in setting the public health objective of the IRM in the 1984 ROD). Both the NAS and CAG risk assessments were based on the same toxicological data, however, different assumptions were utilized in developing the cancer risk estimates. The California DHS action level is still based on the NAS risk assessment for PCE.

Although the proposed MCLG for PCE is 0 and the new draft health advisory of the EPA Office of Drinking Water is 0.7 ppb (as the 10^{-6} cancer risk level), it is recommended that the PCE concentration limit be set at 1 ppb for the San Gabriel Area 1 interim remedial action. Since no MCL exists yet for PCE, the CAG health advisory, along with the DHS action level, should be considered in the development of applicable or relevant and appropriate requirement for PCE. The standard detection limit obtained by a good laboratory for PCE, analyzed in conformance with EPA Method 601 for purgable halocarbons, is 1 ppb, and confidence levels for concentrations of less than 1 ppb are questionable. The recommended alternative, installation of a carbon adsorption treatment system, will have no problem reducing PCE levels to below the detection limit at essentially no additional cost over the cost of just meeting the DHS action level (and goal of the IRM in the 1984 Record of Decision). Therefore, a PCE concentration limit of 1 ppb is recommended since it appears that this level is simultaneously most protective of public health and technologically feasible. Several other Federal, State, and local environmental requirements are applicable or relevant and appropriate and have been considered in developing the IRM alternatives.

Meeting Applicable or Relevant and Appropriate Requirements

In developing the different IRM alternatives, it has been assumed that each alternative would be implemented so that it would comply with all Federal, State, and local environmental requirments.* The specific requirements as they apply to each of the alternatives are summarized here:

Air-Stripping -- The conceptual design and cost estimates of the air-stripping alternatives (with and without the in-ground storage reservoir), as described in the 1986 pre-design studies, are based on a cleanup goal of 4 ppb for PCE. In order to treat groundwater (with contaminant levels at the maximum design concentrations) to the detection limit of PCE (1 ppb) and approach the 10^{-6} cancer risk level as stated in the EPA drinking water health advisory, the air-to-water ratio would need to be increased by up to 20%. In addition, the packing depth of the towers would have to be increased by 15-20 feet. As a result, capital costs would be significantly higher, and the cost of power to operate the system would also be significantly increased. [Note: These additional costs to treat to the detection limit for PCE are not included in the cost summaries on pp. 17-20 and in Table 1. The cost in those tables assume a target concentration of 4 ppb PCE.]

The air-stripping alternatives would be affected by several environmental requirements. Since an air-stripping system would emit PCE to the atmosphere from the top of the stripping tower, it would be subject to the South Coast Air Quality Management

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* Note: In accordance with the provisions of §121(e)(1) of the Superfund Amendments and Reauthorization Act of 1986 (SARA), the initial remedial measures implemented will meet the substantive requirements of the Federal, State, and local environmental laws and regulations cited in this section. EPA is not required, however, to obtain the Federal, State, or local permits required under these laws and regulations. Nevertheless, the mutuals may apply for the normally required permits in the course of EPA implementation of the selected initial remedial measures. EPA reserves the authority under SARA to implement the project without obtaining permits (while meeting all the substantive requirements that apply) if it is necessary to maintain the project schedule.

District's (SCAQMD) Rule No. 402. In anticipation of complying with SCAQMD's requirements, Richwood and Rurban Homes submitted air emissions permit applications to SCAQMD in September 1985. SCAQMD's permit review process for air-stripping towers consists of a modeling analysis to determine the maximum ambient concentration of pollutants that would occur due to the system's emissions, followed by a calculation of the maximum individual cancer risk that would be associated with that ambient concentration. As part of SCAQMD's review of Richwood and Rurban Homes' permit applications, SCAQMD staff performed a screening air quality model analysis of the maximum estimated emissions from the air-stripping systems. Estimated maximum long-term (annual-average) ambient concentrations of PCE (and other trace contaminants, trichlorethylene and carbon tetrachloride) were developed. Based on EPA estimates of cancer risk levels associated with exposure to ambient concentrations of these contaminants, SCAQMD calculated the maximum individual risk associated with exposure to the emissions from the air-stripping systems. For Richwood, the maximum individual cancer risk was $6x10^{-7}$, while for Rurban Homes the maximum individual cancer risk was $7x10^{-8}$. Both of these risk estimates are below the 10^{-6} cancer risk level being used as the target risk level for exposure to PCE in the mutuals' drinking water.

The air-stripping systems would also be subject to requirements of the Clean Water Act as established under a National Pollutant Discharge Elimination System (NPDES) permit. The Clean Water Act is administered by the Los Angeles Regional Water Quality Control Board (RWQCB). The air-stripping system would fall under NPDES requirements due to the planned discharge of wastewater associated with the periodic (approximately monthly) disinfection of the air-stripping towers to a nearby storm sewer system. The discharge would also comply with requirements of the Los Angeles County Department of Public Works which regulates discharges to the storm sewer system.

The air-stripping system would also be subject to requirements of the Sanitary Engineering Branch (SEB) of California DHS, as well as the Planning Department of the City of El Monte. DHS requirements involve a modification to the mutuals' present water supply system permit, and primarily consist of DHS approval of the modification to the mutuals' water supply system. The City of El Monte has requirements for conditional use permits in situations where non-residential facilities are constructed in a zoned residential area, such as where the mutuals' well sites are now currently located.

Carbon Adsorption -- The carbon adsorption alternative would treat PCE in groundwater to detection level (1 ppb) and thereby achieve the most protective technologically feasible cleanup level. The existing carbon adsorption system conceptual designs could meet this objective without any significant additional cost.

This alternative is subject to the same requirements as is the air-stripping alternative with the exception of the SCAQMD requirements (since the carbon adsorption alternative would involve no emissions to the air). Therefore, DHS and City of El Monte requirements would apply, as well as NPDES requirements and Los Angeles County Department of Public Works requirements. In this case, however, the wastewater discharge subject to NPDES requirements is the periodic backwash of the carbon beds. Clean water is forced through the beds to eliminate channeling and reduce packing of the beds to improve carbon adsorption system performance. The backwash water would then be discharged to the storm sewer. This discharge would be subject to NPDES requirements, as well as Los Angeles County Department of Public Works requirements.

In keeping with SARA preference for using treatment technologies that significantly and permanently reduces the volume, toxicity or mobility of contaminants to the maximum extent practicable, the spent carbon would be regenerated for reuse through high temperature incineration. This would essentially permanently destroy the contaminants. If the spent carbon is determined to be a hazardous substance, it will require disposal or treatment in accordance with RCRA regulations.

Connect to MWD and Join With Another Water Company -- The primary requirement affecting these two alternatives would be the DHS public water supply permit requirements due to the modification of the mutuals' present water supply system. The Connect to MWD alternative, however, would also be subject to City of El Monte Planning Department requirements concerning the construction of the storage reservoir. Currently, the State Action Level of 4 ppb of PCE is the level to which the public water suppliers in San Gabriel areas 1-4 are operating to achieve. The <1 ppb concentration level, which would be achieved under the carbon adsorption alternative, would not necessarily be achieved by connecting to another water company.

Bottled Water -- This alternative would not be subject to any specific requirements. With regards to EPA's proposed MCL standards for other volatile organic compounds (and likely to apply to a PCE MCL as well), bottled water is not considered an acceptable permanent means of meeting MCL requirements (50 Federal Register, pg. 46916), although it is considered an acceptable interim measure until permanent means of meeting the MCL are implemented. Therefore, in this situation where the IRM is considered an interim remedy to provide the mutuals with clean water in the interim period until a comprehensive remedial action is implemented, bottled water can be considered an acceptable IRM alternative in accordance with EPA's proposed MCL standards for volatile organic compounds.

VI. Recent Community Relations Activities

Based on the new information regarding the costs of air-stripping and carbon adsorption systems EPA prepared a draft report, "Revised Cost-Effectiveness Analysis of Alternatives for the San Gabriel Area 1 Initial Remedial Measures." This report proposed that EPA revise its previous decision selecting air-stripping as the cost-effective alternative for the San Gabriel Area 1 Initial Remedial Measures and now select carbon adsorption as the cost-effective IRM alternative. In October 1986, EPA released this draft report for public review and comment. A fact sheet that summarized the report and EPA's proposed action was prepared and distributed to everyone on the San Gabriel sites mailing list. In addition, EPA provided the three mutuals with copies of the fact sheet for distribution to their shareholders. Copies of the report were distributed to California DHS and directly to the three mutual water companies affected. The report was made available at three information repositories that had been previously established for this project: 1) El Monte Public Library in El Monte; 2) Norwood Public Library in El Monte; and 3) EPA Region 9 Office in San Francisco. The fact sheet that was distributed announced the availability of the report, the location of the information repositories, and the scheduled public comment period which ran from October 10, 1986 to October 31, 1986.

A public meeting was not scheduled during the public comment period. It was felt that the interest level in this proposed action did not warrant a public meeting. Less than ten members of the public attended the December 19, 1983 public meeting that was held to accept comments on the December 1983 Focused Feasibility Study. No individuals in attendance at that meeting chose to make an oral statement or to submit written comments at that time. Only two public comments were submitted during the December 1983 public comment period. In addition to the lack of interest in EPA's proposed project in the past, it was also known from meetings with the mutuals' board members that the mutuals supported EPA's proposed change of selection of remedy for the IRM. Therefore, it was decided to forego the scheduling of a public meeting unless requests for such a meeting were obtained for the public--no such requests were received. EPA did offer to schedule a meeting for the mutual members upon request.

EPA received two written comments during the public comment period. One commentor supported the selection of the alternative under which the mutuals would dissolve and join another water company. The second commentor while stating a preference for the carbon adsorption alternative, believed that air-stripping treatment is the most cost-effective alternative. EPA's response to these comments is summarized in the attached responsiveness summary.

In addition to the public comment period, EPA specifically asked the mutuals to respond to EPA with their preferences regarding the alternative initial remedial measures. Both Richwood and Rurban Homes Mutual Water Companies provided letters to EPA stating that they were in agreement with the EPA proposal to revise the selection of alternative for the San Gabriel Area 1 initial remedial measures from air-stripping to carbon adsorption treatment systems. The president of Hemlock Mutual Water Company advised EPA that the Hemlock board of directors had decided not to request that the proposed upgrade to their carbon adsorption system be implemented, and therefore, requested that they not be included in the initial remedial measures project at this time.

VII. Current Status of the Mutuals' Water Supply

Richwood Mutual Water Company

In June 1985, the PCE level in Richwood's North Well approached 100 ppb (and one sample collected by the mutual showed a concentration of 110 ppb PCE). Because these contaminant levels are approximately 25 times the state action levels, DHS made a determination of imminent or substantial endangerment, pursuant to section 25358.3 of the health and safety code, and funded the installation of a temporary emergency connection of Richwood to the San Gabriel Valley Water Company (SGVWC). Since that time, Richwood's wells have been shut down and its members have been obtaining their water from SGVWC. SGVWC entered into a temporary service agreement with Richwood that provided for SGVWC to furnish water to Richwood on a temporary basis until the water treatment system being constructed by EPA was installed and in operation. SGVWC reserved the right to limit, curtail, or terminate the agreement at its discretion if in its judgement, it determines that conditions within its water system warrant such limitation, curtailment, or termination. Because of the temporary nature of the agreement and its implementation on the assumption that EPA would continue to design and install a treatment system, it is recommended to continue with the implementation of the initial remedial measures for Richwood Mutual Water Company at this time.

Rurban Homes Mutual Water Company

The last time Rurban Homes' wells were sampled (1/31/85) before the October 1986 public comment period on EPA's revised cost-effectiveness analysis, Well No. 1 showed a PCE concentration of 4.4 ppb, just above the DHS action level. This well has had a maximum PCE concentration of 54 ppb in the past. Since the public comment period, the wells have been sampled monthly for the first five months of 1987 as part of the Assembly Bill 1803 sampling program currently being conducted by the Main San Gabriel Basin Watermaster. All of the historical sampling data from Rurban Homes' wells that are in the current San Gabriel remedial investigation/feasibility study (RI/FS) database are listed in Tables 3 and 4. PCE has not been detected at all in Well No. 2 in 1987. The laboratory has reported values of PCE of 0.68 - 1.14 ppb in Well No. 1 in five samples collected in 1987. This is essentially the limit of quantification for PCE analysis. At this stage in the San Gabriel RI/FS, the knowledge of the sources, extent, and character of the groundwater contamination is not detailed enough to determine the reason for this drop in contamination levels. The influence of other wells pumping in the vicinity or changing water levels may have affected contaminant migration, or a slug of contamination may have passed through the Rurban Homes well field.

It is recommended that initial remedial measures for the Rurban Homes Mutual Water Company be not implemented at this time since the contaminant levels have remained steady at the levels recommended as the public health goal for the IRM through the first half of 1987. It is also recommended, however, that the design and preparation of bid documents for the IRM for Rurban Homes be completed at this time. The reason for this is that there have been several wells in the San Gabriel Valley that have had contaminant levels that have fluctuated from below DHS action levels to levels much higher than DHS action levels. Given our lack of knowledge of the character of the groundwater contamination in the vicinity of the Rurban Homes wells, it would be prudent to have the design completed so that if regular monitoring shows the contaminant levels increasing again or if other investigations determine that upgradient contamination threatens the wells, immediate action can be taken to protect public health. This approach has been discussed with the President of the Rurban Homes Board of Directors, who had no objections to this approach and informed the other members of the Board of Directors.

Hemlock Mutual Water Company

Hemlock's existing carbon adsorption system was designed in 1983 and became operational in March 1986. It is currently operating and is treating water pumped from Hemlock's two wells. Sampling data for 1987 show contaminant levels in Hemlock's two wells ranging from less than 10 ppb PCE (including one analysis that came back nondetectable for PCE) to as high as 150 ppb. The existing carbon adsorption system has an empty bed contact time (EBCT) of 5 minutes at peak flow, with peak flow limited to 360 gallons per minute. The normal design criteria EBCT for carbon adsorption systems treating water contaminated with volatile organic compounds is 10-15 minutes.

It was proposed to upgrade Hemlock's existing system to the design standards of the Richwood and Rurban Homes carbon adsorption system conceptual designs. Hemlock informed EPA that it did not wish to have the upgrade of its existing system implemented at this time. Nevertheless it is recommended to still select a cost-effective IRM alternative for Hemlock, but to not implement it at this time. It would be implemented in the future only is it is determined that there are problems with their present system that make it necessary to implement the IRM alternative in order to protect public health. This would allow EPA to take more expeditious action in the event that additional action to protect public health is necessary.

VIII. Comparison of Alternatives

As previously discussed, much work has been done to further evaluate the air-stripping and carbon adsorption alternatives since the Record of Decision for the San Gabriel Area 1 IRM was approved in May 1984. This additional evaluation, along with the development of more refined estimates of the amount of water used by the mutuals, has led to cost estimates that are very different from those identified in the Record of Decision. In addition, there has been further evaluation of the non-cost factors that should be taken into account in the selection of an IRM alternative for implementation. In this section, the relative advantages and disadvantages of the IRM alternatives that were considered are discussed. These advantages and disadvantages are also summarized in Table 2.

Treatment of Well Discharge With Air-Stripping System

Two different configurations of the air-stripping system alternative were considered. The air-stripping configuration that does not include an in-ground storage reservoir was the second lowest-cost alternative. This configuration of the air-stripping system alternative is the IRM action originally selected in the May 1984 Record of Decision. Although this air-stripping system configuration has a lower overall cost than the configuration that includes the reservoir, it was determined during the Pre-Design Study prepared by CH_2M Hill (CH_2M Hill, 1984) that this configuration (without a storage reservoir) could have potentially serious problems regarding the reliability of the system. The constant cycling on and off of the system could cause excessive equipment wear. Also, this configuration would require a microprocessor control system to control the cycling of the system. The mutuals presently have no experience in operating a complex control system.

In addition, this configuration may cause several negative impacts on the mutuals and the surrounding community. These impacts include: 1) potential noise problems associated with near 24-hour operation of the air-stripping towers; 2) possible frequent power surges and disruptions caused by the constant cycling on and off of electrical equipment associated with the treatment system; and 3) a major change in the way the mutuals operate their water systems since they presently have no experience in operating a complex waterworks system.

By including a storage reservoir in the air-stripping system, the potential for problems concerning system reliability is reduced, while the other adverse impacts on the mutuals and surrounding community are also mitigated. The inclusion of a storage reservoir however, increases the 5-year cost of air-stripping to the point where it is higher in cost than every alternative except for providing bottle water to the mutuals. Also, construction of a 60,000 gallon storage reservoir at the mutuals' well sites would be difficult due to the limited site area available, particularly at Richwood's well site. Excavation of the reservoir would be a major operation that would have a large effect on the neighboring landowners since the construction would have to be staged on the adjacent lots.

There are two advantages that are common to both air-stripping configurations. First, air-stripping has the lowest annual cost (O&M plus increased water costs) of all the alternatives. Also, the annual cost is not as sensitive to the level of system. Second, the air-stripping treatment system has the advantage of actually beginning to clean the contaminated ground water that is present. Thus, it is consistent with a long-term goal of restoring the aquifer to an uncontaminated state and ensures that at least in the area of influence of the mutuals wells, the contamination will not continue to migrate, thereby potentially affecting other wells. Of course, there is also a small possibility that continuing to pump the ground water could draw pockets of highly contaminated ground water toward existing wells, however, the effect of the pumping cannot be predicted definitively at this time since the extent of contamination has not been entirely defined.

Both configurations of air-stripping also share several disadvantages, as well. One disadvantage is the size of the systems and its associated visual impact. The stripping towers would be approximately 30-35 feet tall, and therefore, would stand out in a residential neighborhood of predominantly single-story buildings. If contaminant concentrations exceed the maximum design concentrations, the air-stripping system may not meet the public health objective of the IRM without modification of the system. Air-stripping would also not be effective if other, nonvolatile organic compounds (VOC) are present in the ground water. Based on the results of EPA, state, and local water agency sampling, however, it appears that only VOC contamination is prevalent in San Gabriel Area 1. Another disadvantage is that air-stripping systems would emit measureable amounts of PCE into the atmosphere. This is a potential concern since the location of the wells is in the highly polluted South Coast Air Quality Basin. As previously discussed, SCAQMD modeling of the emissions concluded that the maximum individual cancer risk levels associated with the air emissions from the air-stripping towers would be less than the 10^{-6} cancer risk levels on which the public health objective for drinking water in the IRM is based. However, there is a non-zero risk ($6x10^{-7}$) associated with the air emissions which may be of concern to the community since the treatment systems would be constructed in the middle of residential neighborhoods. Finally, a major disadvantage of the air-stripping alternative is that it would have a negative impact on the affected community due to the estimated increase in the average household water bill of 140-180% for the mutuals' members

Another disadvantage with the air-stripping systems are that the existing conceptual designs (and the associated cost estimates) as described in the 1986 pre-design studies, are based on a cleanup goal of 4 ppb for PCE. In order to treat groundwater to the detection limit of 1 ppb (which approaches the 10^{-6} cancer risk level of 0.7 as stated in the EPA draft health advisory for PCE), the air-to-water ratio would need to be increased by up to 20%. In addition, the packing depth of the towers would probably have to be increased by 15-20 feet. As a result, the capital costs would be significantly higher than currently estimated and the power costs would increase during operation.

Finally, a last disadvantage is that the air-stripping alternative just transfers the contaminants from water to air, and thus, does not meet the SARA preference for using treatment technologies that would significantly and permanently reduce the volume, mobility, and toxicity of contaminants to the maximum extent practicable.

Join With Another Water Company

Of the other potential alternatives, Alternative 4--Join With Another Water Company--has the lowest overall cost. This alternative, however, cannot be implemented unless the mutuals vote to dissolve as independent water companies and transfer their water rights to the San Gabriel Valley Water Company. When this alternative was presented to the mutuals as a potentially cost-effective IRM after completion of the FFS, the mutuals' shareholders voted to remain independent. Therefore, though this alternative is a low-cost and effective alternative, it cannot be implemented.

Also, as was discussed in Section IV., although the other alternatives would under most conditions attain the proposed RMCL of 0 for PCE in the water being delivered to the mutuals, this alternative potentially would not. This is due to the fact that the San Gabriel Valley Water Company currently has several contaminated wells and must treat some water or blend clean and contaminated water to ensure that all water delivered to customers meets the public health objective of the IRM of 4 ppb (equal to the DHS "Action Level"). Therefore, while this alternative would definitely meet the public health objective of the IRM, it may not attain the health-based goal for drinking water quality as identified in the proposed RMCL for PCE. In addition, unlike the treatment alternatives, air-stripping and carbon adsorption, under this alternative no steps would be taken to remove the contaminants from the ground water, thereby allowing the contamination to continue to migrate while the mutuals' wells are shut down.

In addition, this alternative would have the adverse impact on the affected community of raising the average water bill of the mutuals' members by an estimated 170-220%. It would also be irrevocable, in that once the mutuals are taken over by another water company, the situation is premanent. Thus, through a contamination problem that was no fault of their own, the mutuals' members would face higher water bills in prepetuity even if contamination levels in their wells were to be reduced drastically by future remedial actions and/or contaminant migration.

Bottled Water

Providing bottled water to the mutuals is the highest cost alternative. This alternative has a 5-year cost of more than three times the next highest cost alternative. It would also be less effective than the other alternatives since it would be provided only for cooking and drinking, while the mutuals' members could still be exposed to PCE while bathing. Since it costs more and would be less effective than the other alternatives, it is not a cost-effective alternative.

Connection to the Metropolitan Water District

The remaining two alternatives (connection to MWD and carbon adsorption) both have approximately the same 5-year cost, approximately 15-20% below the 5-year cost of the air-stripping system configuration that included the storage reservoir. Although connecting to MWD would effectively meet the public health objective of the IRM, there are several disadvantages to implementing this alternative. First, the high cost of water from MWD would have a large impact on the mutuals' members. This alternative would lead to an increase in the average household's water bill of from 140%-200%. The water bills would probably increase further because, although constant annual costs were assumed in the cost estimates for this alternative based on MWD's current water prices, the cost of MWD water is expected to rise 10% per year over the next 5 years.

Second, the actual capital cost of implementing this alternative may be higher than estimated. The uncertainty in capital cost for this alternative is greater than the other alternatives because the estimate was made without a particular location (which would be away from the mutuals' well sites) for the storage reservoir identified. Factors such as variance in land costs, distance to the MWD aqueduct and the mutuals' distribution systems, ease of obtaining easements for pipeline construction, and site characteristics could all affect the final implementation costs.

Third, another disadvantage of this alternative is that it is likely that more time will be required to implement this remedy. Air-stripping or carbon adsorption systems can probably be designed and constructed in approximately 8 months. To connect the mutuals to MWD would probably take over a year since the reservoir site would have to be located, negotiations over the price of the property conducted, title closure would have to take place, easements for pipeline construction would have to be obtained, and then finally the design and construction of the waterworks facilities could occur.

Fourth, as with the alternative of joining with another water company, under this alternative no steps would be taken to remove the contaminants from the ground water, thereby allowing the contamination to continue to migrate while the mutuals' wells are shut down.

Treatment of Well Discharge With Carbon Adsorption

The remaining alternative, carbon adsorption, has a 5-year cost approximately equal to the cost of connecting the mutuals to MWD. It is approximately 15% more costly than the air-stripping configuration that does not include the storage reservoir, but 15% less costly than air-stripping when the storage reservoir is included. A carbon adsorption treatment system has several non-cost advantages. Its installation small well sites would be easier than installing the air-stripping system with the in-ground reservoir since the excavation necessary would be much less. Although Richwood's carbon adsorption system (and one of the Hemlock subalternative systems) would require excavation to install the backwash system, the excavation would be much less involved since the size of backwash storage is only 14,000 gallons as compared to the 60,000 gallon storage reservoir planned for the air-stripping system (with storage reservoir). It would, however, be more difficult to install than the air-stripping alternative that does not include the reservoir storage. Carbon adsorption also offers potential public health advantages since it can remove a wide spectrum of organic pollutants in addition to PCE. In addition, if contaminant levels rise above the design concentration levels, a carbon adsorption system should still be able to adequately remove the contaminants (although operating costs may increase accordingly). This is potentially a major advantage given the fact that the plume of ground water contamination in San Gabriel Area 1 is not completely characterized and pockets of high contamination or multiple contaminants may not have been identified yet. In addition, the current carbon adsorption design can treat the water down to the detection limit of PCE (1 ppb), thereby essentially meeting the 10^{-6} cancer risk level for PCE as stated in the EPA draft health advisory without any modification of the system and at essentially no or minimal additional cost (the carbon may have to be recharged slightly more often to maintain the 1 ppb level in effluent water).

The carbon adsorption alternative has several important advantages regarding the expected impacts on the affected community. A carbon adsorption system will have less potential for creating a noise problem in the community than the air-stripping alternative (although new booster pumps will increase the noise somewhat). As a smaller system, there will be less visual impact in a community of single-story residential homes if carbon adsorption is implemented instead of air-stripping. Finally, because of the intention of DHS to implement the provisions of SB 1063, there will be no adverse financial impact on the mutuals' members from implementation of the carbon adsorption alternative since DHS will provide funding for system O&M.

The primary disadvantage of carbon adsorption is that its annual costs are significantly higher than any of the other alternatives (except bottled water). This is a disadvantage if the IRM alternative is operated beyond the estimated five years before a comprehensive remedial action is implemented for San Gabriel Area 1. The following table presents the overall costs if 20 years is used as the project life instead of 5 years (20 years can be considered the design life of the treatment system equipment).

TWENTY YEAR PRESENT WORTH COSTS ASSOCIATED WITH SELECTED IRM ALTERNATIVES

Alternatives	Capital Costs	20-Year Present Worth O&M or Increased Water Costs	20-Year Present Worth Costs
Air-Stripping (with storage reservoir)	$ 2,833,000	$ 978,000	$ 3,811,000
Air-Stripping (without storage reservoir)	$ 1,949,000	$ 978,000	$ 2,927,000
Carbon Adsorption	$ 1,616,000-[1] 1,772,000	$ 2,396,000-[1] 2,581,000	$ 4,073,000-[1] 4,197,000
Connect with MWD	$ 2,135,000	$ 1,181,000	$ 3,316,000

1) The range of cost figures represents the difference in total costs for all three mutuals depending on which subalternative method of upgrading Hemlock's existing carbon adsorption system is implemented. The total cost figure does not equal the sum of the ranges given for capital and O&M costs because the Hemlock subalternatives with higher capital costs have lower O&M costs.

As can be seen from the table, on a twenty-year basis, the cost of carbon adsorption is 9% higher than the cost of the air-stripping configuration that includes a storage reservoir, 25% higher than the cost of connecting to the MWD (although this is based on the highly unlikely assumption of a constant cost for MWD water over 20 years), and 40% higher than the air-stripping configuration that does not include a storage reservoir.

Another disadvantage of the carbon adsorption alternative is that there will be a small amount of air emissions associated with the regeneration of the carbon at the carbon recycler's regeneration facility. The amount of emissions, however, would be substantially less than the emissions associated with the air-stripping alternative, since they will be controlled at the recylcer's facility. Also, by using high temperature incineration to regerate the carbon for reuse, this alternative meets the SARA preference for using to the maximum extent practicable treatment technologies that significantly and permanently reduces the volume, mobility, and toxicity of contaminants, as the regeneration process essentially permanently destroys the contaminants trapped in the spent carbon.

IX. Recommended Alternative

SARA, in addition to Section 300.68(i) of the National Contingency Plan (40 CFR Part 300), defines the appropriate extent of remedial action. Remedies must be protective of human health and the environment. Remedies that attain or exceed applicable or relevant and appropriate requirements are protective. The selected remedy must also be cost-effective; that is, it must confer a level of protection that cannot be achieved by less costly alternatives. SARA expresses a preference for treatment that permanently and significantly reduces volume, toxicity, or mobility of contaminants to the maximum extent practicable.

This revised cost-effectiveness analysis has summarized the additional evaluation of cost estimates and other non-cost factors concerning potential IRM alternatives that has occurred since the IRM Record of Decision was signed in May 1984. On the basis of this evaluation, EPA has determined that the May 1984 decision selecting air-stripping as the cost-effective alternative be revised, and that carbon adsorption be selected as the cost-effective IRM alternative, including the upgrade to Hemlock's current carbon adsorption system.

There are three alternatives with a total 5-year cost below that of carbon adsorption. The lowest cost alternative (join with another water company), however, has been determined to be institutionally infeasible because the mutuals would not approve it. The next lowest cost alternative, an air-stripping system that does not include a storage reservoir has potential reliability problems, and could cause several adverse impacts on the affected community. The third lowest cost alternative, connect to MWD, is virtually equal in cost to carbon adsorption when taking into account the accuracy of the cost estimates (the estimated cost of carbon adsorption is within 3-8% of the estimated cost of connecting to MWD). Of these lower cost alternatives and the remaining alternatives, however, carbon adsorption has a better balance of advantages to disadvantages as far as non-cost factors are concerned. The primary advantages of the carbon adsorption alternative are:

- More protective of public health since it can treat to the detection limit of PCE (without any additional cost, unlike the air-stripping design which would have to be modified to achieve that level of treatment) and will entail minimal air emissions of PCE (at a thermal regeneration facility). Also, carbon adsorption can effectively treat contaminant levels much higher than previously found in the mutuals wells and can remove other non-VOC organics if they contaminate the wells. These latter advantages are potentially significant due to our lack of definitive knowledge regarding the sources, extent, and character of the San Gabriel Valley groundwater contamination at this early stage of the remedial investigation/feasibility study.

- Meets SARA preference for use of treatment technologies by essentially destroying contaminants trapped on spent carbon during the thermal regeneration process.
- With SB 1063 being implemented by DHS, the financial impact on the mutuals' members is mitigated through the State's funding of operation and maintenance. With the other alternatives, the water bill for the mutuals' members would increase by 140 - 220%. In addition, potential problems caused by the mutuals' lack of experience in operating a complex water treatment system would be avoided with DHS operation of the systems.
- Smaller potential impacts on the community (such as less visual impact and less potential for noise impacts) than the air-stripping alternative without the storage reservoir.
- By continuing to use the mutuals' wells rather than shutting them down, may contribute to reduced migration of contamination (though to what exent, if any, is unknown at this time due to our lack of knowledge concerning the sources and extent of contamination) than if non-treatment alternatives (e.g., connection to the Metropolitan Water District) is implemented.

The only significant disadvantage for carbon adsorption is that its annual costs are much higher than other alternatives so that over a long period of time it would be an even more costly alternative. Although it is possible that the IRM may become part of the final remedial action alternative, the objective of the IRM is to provide a solution for the mutuals' contamination problem in the interim period before the San Gabriel Areas 1-4 Remedial Investigation/ Feasibility Study is completed and a more comprehensive remedial action is implemented, which is expected to take approximately 5 years. On a 5-year basis, the cost of carbon adsorption is favorable compared to the other alternatives when taking into account its non-cost advantages.

A cost summary of the recommended alternative is shown in the table on the following page. While the selection of the carbon adsorption alternative for all three mutuals is recommended, it is also recommended that only the Richwood system be installed at this time. It is recommended that the design and development of bid documents for the Rurban Homes system be completed at this time, but that actual installation of the system only occur if continued monitoring of the contaminant levels in Rurban Homes' wells or other investigations show an increase or potential increase in the contaminant levels in their wells for which it is determined the treatment system is necessary to protect public health. In addition, since Hemlock requested that the upgrade to their system not be implemented at this time, it is recommended that it be implemented in the future only if it is determined that there are problems with their present system that make it necessary to install the upgrade to protect public health.

COST SUMMARY OF THE SELECTED ALTERNATIVE

Mutual	Capital Cost	5-Year Present Worth	Total 5-Year Present Worth
Richwood	$ 684,500	$ 352,000	$ 1,036,500
*Rurban Homes	$ 687,100	$ 404,000	$ 1,091,100
**Hemlock (upgrade to present system)	$ 244,500-400,200	$ 310,000-392,000	$ 615,700-716,200***

* Due to the recent drop in contaminant levels in Rurban Homes' wells, the treatment system will not be implemented at this time if continued monitoring of the wells shows the contaminant levels remaining near detection limit (1-4 ppb). However, complete design plans and bid documents will be prepared and EPA will implement the alternative if future monitoring and investigations show a rise or potential rise in the contaminant levels found in the wells.

** In response to Hemlock's preference, the upgrade to their present system will not be implemented at this time. However, if their system has problems in the future, EPA will implement the upgrade to their system.

*** The range of cost figures represents the difference in costs depending on which subalternative method of upgrading Hemlock's existing system is implemented. The subtotals and total cost figures do not equal the sum of the ranges of the different cost elements because the different subalternatives with higher capital costs have lower operating costs.

Continued Operations and Operation and Maintenance

DHS will be responsible for continued operations and operation and maintenance (O&M) of the carbon adsorption systems once they are installed. EPA will provide 90% of the funding for continued operations of the treatment system until the final remedial action alternative for San Gabriel Area 1 is implemented (currently estimated as approximately 5 years). Funding will be provided to DHS through a Cooperative Agreement. The annual continued operations and O&M costs for the Richwood carbon adsorption system (the only system being implemented at this time), as well as the estimated O&M costs for the Rurban Homes system and Hemlock's system if it was upgraded, are shown below:

Mutual	Annual Continued Operations and Operation & Maintenance Costs
Richwood	\$ 93,000
Rurban Homes	\$ 106,600
Hemlock	\$ 81,800 - \$ 103,500

Schedule

Complete Design	November 30, 1987
Complete Construction	June 30, 1988
Award of Cooperative Agreement for Continued Operations Costs	June 30, 1988

Future Actions

The overall RI/FS for the San Gabriel Areas 1-4 sites is currently underway. An initial phase of the remedial investigation, the Supplemental Sampling Program, was completed in 1986. The workplan for the next phase of the RI/FS is currently being developed. In addition, the Region is examining alternative approaches to completing the RI/FS and implementing remedial actions in the San Gabriel Valley. It is currently estimated that the RI/FS will take approximately 5 years to complete, though this is somewhat dependant on the overall approach that EPA takes in completing the RI/FS.

TABLE 1

SAN GABRIEL AREA 1
INITIAL REMEDIAL MEASURES

REVISED COST ESTIMATES OF ALTERNATIVES

Alternative	Capital Costs ($)	5-Year Operation & Maintenance ($)	5-Year Increased Water Costs ($)	Total 5-Year Costs ($)
1. Treat Well Discharge with Air-Stripping System				
A. Without Storage Reservoir	1,949,000	436,000	-	2,385,000
B. With Storage Reservoir	2,833,000	436,000	-	3,269,000
2. Treat Well Discharge with Carbon Adsorption System[1]	1,616,000-1,772,000	1,066,000-1,148,000	-	2,743,000-2,844,000
3. Connect to Metropolitan Water District	2,135,000	75,000	451,000	2,661,000
4. Join with Another Water Company	202,000		522,000	724,000
5. Bottled Water	-	10,459,000	-	10,459,000

1) The range of cost figures represents the difference in total costs for all three mutuals depending on which subalternative method of upgrading Hemlock's existing carbon adsorption system is implemented. The total cost figure does not equal the sum of the ranges given for capital and O&M costs because the Hemlock subalternatives with higher capital costs have lower O&M costs.

TABLE 2

SAN GABRIEL AREA 1
INITIAL REMEDIAL MEASURES

SUMMARY OF ALTERNATIVES

Alternative	Public Health Concerns	Environmental Concerns	Technical Concerns	Impact on Community	Other
Air-Stripping	°emissions of PCE to air leading to a maximum individual increased cancer risk of up to $6x10^{-7}$ °would not be effective if other non-VOC organics contaminate wells °will not meet 10^{-6} cancer risk level w/o system modification, or meet action level if concentration of PCE rises above design maximum	°would block continued migration of contamination °would emit PCE removed from water into air (see public health concerns)	°proven technology w/o storage res.: °potential reliability problems due to excessive equipment wear and operational complexity with storage res.: °potential reliability problems reduced substantially °difficult to design and construct due to small areas available for construction	°large increase (140-180%) in water bills of mutual members °high visual impact in a residential neighborhood w/o storage res.: °potential noise problems due to 24-hr. operation °possible frequent power surges & disruptions due to constant cycling of system	°annual costs not very sensitive to level of contamination °lowest annual cost of all alternatives w/o storage res.: °alternative with 2nd lowest overall cost with storage res.: °alternative with 2nd highest overall cost
Join With Another Water Company	°would meet public state action level of 4 ppb PCE, but may not meet new draft health advisory for 10^{-6} cancer risk for PCE	°Does not control continued migration of contaminated ground water	°Relies on simple technology	°large increase (170-220%) in water bills of mutual members °requires permanent irrevocable dissolution of mutuals	°alternative with lowest overall cost °institutionally infeasible as mutuals will not approve dissolution

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SAN GABRIEL AREA 1
INITIAL REMEDIAL MEASURES

SUMMARY OF ALTERNATIVES

Alternatives	Public Health Concerns	Environmental Concerns	Technical Concerns	Impact on Community	Other
Connect to Metropolitan Water District	°would meet state action level and probably meet new draft health advisory for 10^{-6} cancer risk for PCE	°does not control continued migration of contaminated ground water	°relies on simple technology	°large increase (140-200%) in water bills of mutual members °further increases in water bills likely due to rising MWD water costs	°alternative with 3rd lowest overall cost, however, large uncertainty in capital costs °long implementation time (> 1 year)
Bottled Water	°mutual members still potentially exposed to PCE during bathing	°does not control continued migration of contaminated ground water	°relies on simple technology	°no increase in cost of water to mutual members °inconvenience of dealing with bottled water	°alternative with highest overall cost (over 3 times the cost of the next highest cost alternative)
Carbon Adsorption	°can effectively treat contaminant levels greater than design concentration (w/ increase in operating cost) and can treat to detection level for PCE °can effectively remove other non-VOC organics if they contaminate wells	°would block continued migration of contamination °some increased air emissions at carbon recycler's regener- °meets SARA preference for use of treatment technologies by essentially destroying contaminants trapped on spent carbon during regeneration	°proven technology °difficult to design and construct due to small areas available for construction, more difficult than air-stripping w/o reservoir, less than air-stripping with reservoir	°no increase in cost of water to mutual members °some increase in noise levels, although less than air-stripping alternative °potential for electrical surges, though less than air-stripping w/o reservoir	°alternative with 4th lowest overall cost °high annual operating costs (only annual cost of bottled water is higher °annual operating costs sensitive to contaminant levels

TABLE 3

Monitoring Data for Rurban Homes Well No. 2

STATION	PARAMETER	LAB	DATE	VALLE		UNITS	ANOMALY ID
	PERCHLOROETHYLENE	CDHS	80.10.31	14.0000		UG/L	
		CDHS	80.11.14	16.0000		UG/L	
		CDHS	81.01.07	9.8000		UG/L	
		CDHS	81.01.12	9.8000		UG/L	
		CDHS	81.02.19	8.2000		UG/L	
		CDHS	81.06.17	6.5000		UG/L	
		CDHS	81.07.15	7.5000		UG/L	
		CDHS	81.07.23	8.3000		UG/L	
		CDHS	81.08.12	7.0000		UG/L	
		CDHS	81.09.16	11.0000		UG/L	
		CDHS	81.10.14	15.0000		UG/L	
		CDHS	81.11.18	11.0000		UG/L	
		CDHS	81.12.08	5.5000		UG/L	
		CDHS	81.12.18	9.2000		UG/L	
		CDHS	82.01.20	6.9000		UG/L	
		CDHS	82.02.19	4.2000		UG/L	
		CDHS	82.03.11	6.7000		UG/L	
		CDHS	82.03.16	4.1000		UG/L	
		CDHS	82.05.12	3.3000		UG/L	
		CDHS	82.06.08	4.4000		UG/L	
		CDHS	82.06.17	7.3000	3	UG/L	
		CDHS	82.06.18	4.3000		UG/L	
		CDHS	82.06.23	4.0000		UG/L	
		CDHS	82.06.30	4.4000		UG/L	
		CDHS	82.07.07	4.7000		UG/L	
		CDHS	82.07.14	6.1000		UG/L	
		CDHS	82.07.23	4.6900	M	UG/L	
		CDHS	82.08.05	6.3000		UG/L	
		CDHS	82.08.17	6.4000		UG/L	
		CDHS	82.09.22	3.7000		UG/L	
		CDHS	82.09.30	5.9000		UG/L	
		CDHS	82.10.27	1.8000	1	UG/L	
		CDHS	82.11.22	0.4300		UG/L	
		CDHS	82.12.22	0.2200		UG/L	
		CDHS	82.12.29	0.2900		UG/L	
		CDHS	83.02.16	0.3100		UG/L	
		CDHS	83.04.07	1.8000		UG/L	
		CDHS	83.05.17	1.7000		UG/L	
		CDHS	83.08.17	2.4000		UG/L	
		CDHS	83.09.28	1.3000		UG/L	
		CDHS	84.01.10	1.0000		UG/L	
		CDHS	84.01.12	0.1000	U	UG/L	
		CDHS	84.11.13	1.3000		UG/L	
		CDHS	84.11.27	1.7000		UG/L	
		CDHS	85.04.15	0.5000	U	UG/L	
		TRUESDAIL	87.01.23	0.5000	UD	UG/L	DUP 2
		TRUESDAIL	87.01.23	0.5000	UD	UG/L	DUP 1
		TRUESDAIL	87.02.05	0.5000	U	UG/L	
		TRUESDAIL	87.03.03	0.5000	U	UG/L	
		TRUESDAIL	87.04.01	0.5000	U	UG/L	
		TRUESDAIL	87.05.04	0.5000	U	UG/L	

TABLE 4

Monitoring Data for Rurban Homes Well No. 1

STATION	PARAMETER	LAB	DATE	VALUE	UNITS	ANOMALY ID
	PERCHLOROETHYLENE	CDHS	80.10.31	15.0000	UG/L	
		CDHS	80.11.14	20.0000	UG/L	
		CDHS	81.01.07	18.0000	M UG/L	
		CDHS	81.01.12	19.0000	UG/L	
		CDHS	81.02.19	24.3000	UG/L	
		CDHS	81.06.17	11.0000	UG/L	
		CDHS	81.07.15	16.0000	UG/L	
		CDHS	81.07.23	19.0000	UG/L	
		CDHS	81.08.12	7.3000	UG/L	
		CDHS	81.09.16	11.0000	UG/L	
		CDHS	81.10.14	16.0000	M UG/L	
		CDHS	81.11.18	11.0000	UG/L	
		CDHS	81.12.08	11.0000	UG/L	
		CDHS	81.12.18	19.0000	UG/L	
		CDHS	82.01.20	25.4000	3 UG/L	
		CDHS	82.02.09	18.2000	UG/L	
		CDHS	82.04.08	36.0000	UG/L	
		CDHS	82.06.08	36.0000	UG/L	
		CDHS	82.06.18	38.0000	UG/L	
		CDHS	82.06.23	32.7000	3 UG/L	
		CDHS	82.06.30	33.4000	UG/L	
		CDHS	82.07.07	40.0000	UG/L	
		CDHS	82.07.23	35.7600	UG/L	
		CDHS	82.08.05	43.0000	UG/L	
		CDHS	82.08.17	54.1000	UG/L	
		CDHS	82.09.30	45.0000	UG/L	
		CDHS	82.10.27	24.0000	UG/L	
		CDHS	82.11.22	12.0000	UG/L	
		CDHS	82.12.22	2.5000	UG/L	
		CDHS	82.12.29	4.2000	UG/L	
		CDHS	83.04.07	8.3000	UG/L	
		CDHS	83.05.17	3.7000	UG/L	
		CDHS	83.08.17	1.6000	UG/L	
		CDHS	83.09.15	0.1400	UG/L	
		CDHS	83.09.28	2.7000	UG/L	
		CDHS	84.01.10	2.1000	UG/L	
		CDHS	84.01.12	1.3000	UG/L	
		CDHS	84.11.27	6.6000	1 UG/L	
		JMM LAB	85.01.31	4.4000	1 UG/L	
		CDHS	85.04.15	0.1400	UG/L	
		TRUESDAIL	87.01.23	0.8800	UG/L	
		TRUESDAIL	87.02.05	0.8300	UG/L	
		TRUESDAIL	87.03.03	1.1400	UG/L	
		TRUESDAIL	87.04.01	0.6800	UG/L	
		TRUESDAIL	87.05.04	0.9400	UG/L	

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